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THESIS – MASTER OF PHILOSOPHY

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THE FUTURE OF BIOMASS AS A RENEWABLE
ENERGY RESOURCE IN THE CZECH REPUBLIC:
THE CASE OF WASTE WOOD

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Abstract

The Future of Biomass as a Renewable Energy Resource in the Czech Republic: The Case of Waste Wood

The aim of my study was to determine the potential of waste wood as a significant household renewable energy resource that could improve the quality of the environment in the Czech Republic, particularly in the Black Triangle, the most environmentally damaged region in the country. This topic has so far received little attention, despite recent policy development at promoting renewable energy resources.

First it was necessary to establish whether there was sufficient availability of sustainably obtained waste wood. The second question was availability of suitable technology designed for efficient and environmentally friendly combustion of wood. Once these two basic requirements were determined my research followed two goals. First the dissertation aimed to identify factors and influences that play a significant role in the process in which individuals make their decision about the use of wood as a renewable fuel. There were strong reasons to anticipate that people in the Black Triangle who decided to switch to wood as a source of domestic heating in the early 1990s, were led primarily by their environmental beliefs. This hypothesis was not confirmed, although it was found that to a certain degree they were influenced by their environmental attitudes.

The outcomes of the examination of users' experiences with fuel wood identified important barriers to its use as a domestic fuel. The newly emerging government policy was identified as a possible answer to some of the problems arising from this method of household heating in the Czech Republic. The government policy relating to promoting biomass-based renewable energy resources was thoroughly examined. Evidence was found that wood as a fuel has been mostly promoted through financial incentives and dissemination of information.

It was found that availability of wood is an issue that has to be tackled at a local level and in a complex way to ensure that there will be enough fuel in the future for large industrial users, as well as individual users. If combustion of wood is to be environmentally benign method of household heating, several conditions need to be met including the use of specially designed appliances and of wood with water content approximately 20 per cent. Some evidence was found that users do not use the fuel of a suitable quality and consequently pollute the environment.

It was suggested that local authorities' involvement might be instrumental for disseminating know-how for keeping the users informed about environmental consequences of their behaviour as well as providing help with procurement of wood.

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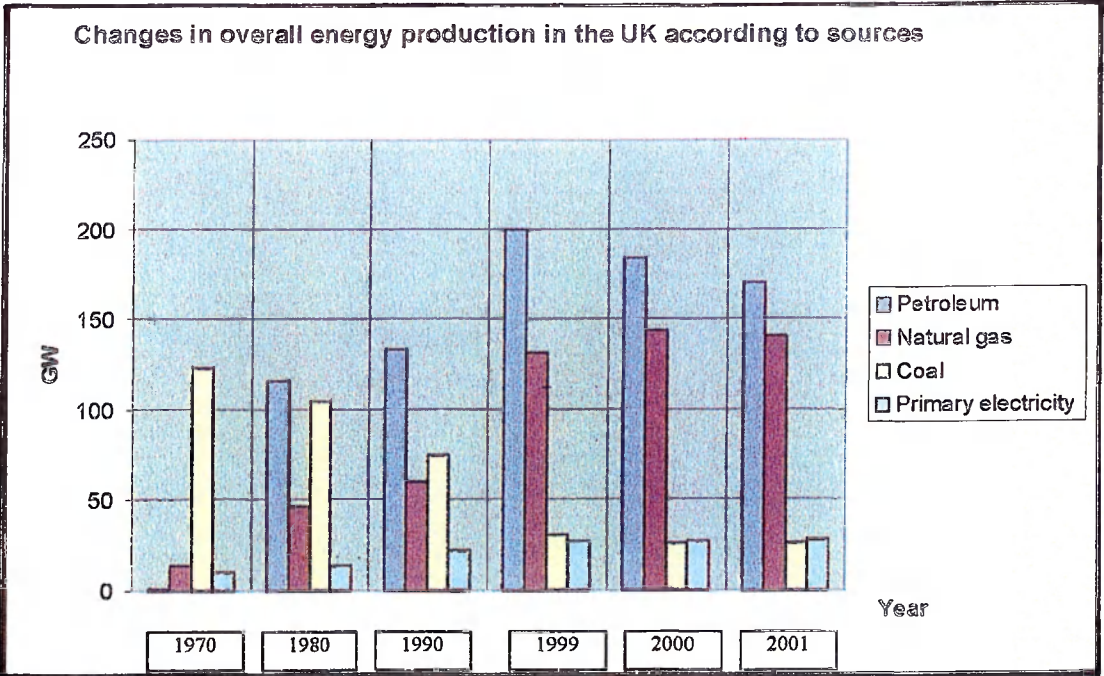
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CHAPTER 1: INTRODUCTION

The emergence of the problem of climate change in the 1980s (Intergovernmental Panel on Climate Change [IPCC] 2001) led to the quest for alternative energy sources to reduce dependence on carbon-based fossil fuels. The attention of scientists, technologists and other academics as well of decision-makers was turning to measures aimed at greater energy efficiency and in parallel, to the shift to renewable energy sources that do not, or at least not in the long-term perspective, interfere with the Earth's climate system.

At the level of household heating, biomass and wood in particular have a potential to be among the most convenient renewable energy fuels in a number of European countries. Although wood was in the past the most common source of domestic heating, in recent decades in industrial countries the use of wood in households became rare as it was replaced by 'modern' fuels such as coal, oil and gas. In the United Kingdom, for example, between 1970 and 2001 the production of petroleum has grown 640-times and natural gas 10-times, while annual coal production gradually decreased to by 2001 to just 20 percent of the 1970s' production. Primary electricity (nuclear and natural flow hydro) grew three times between 1970 and 2001 (UK DTI 2002).

FIGURE 1.1: Changes in Overall Energy Production¹⁾ in the UK According to Sources.



Source: The UK Department of Industry and Trade (2002).

1) Throughout this thesis all data for energy consumption are given in Watts, representing the equivalent rate of consumption averaged over a whole year.

More recently, however, in connection with efforts to curb climate change, wood has begun to be looked at in a more favourable light especially as the new wood-burning technology promised an improved environmental performance. Wood burnt in environmentally friendly appliances offered a viable alternative, decreasing dependence on fossil fuels. The shift to domestic wood burning in efficient boilers became associated not only with sustainability, but also with innovation and modernisation of energy consumption. This dissertation aims to examine the potential for such a shift using the Czech Republic as a case study. The importance of this research is underlined by the fact that former communist countries' economies including the Czech Republic's were marked by much higher energy intensity and thus consumption of fossil fuels than was the case in west European economies. As a

result their per capita contribution to global emissions of greenhouse gases was among the highest in the world.

1.1 History of the Use of Fossil Fuels

People predominantly used wood as an energy resource until the Industrial Revolution (Alexander 1996). Initially, the use of wood was confined to household-related purposes - for heating and preparation of meals. Later, people started to use wood as an energy source for production of goods such as metals, pots and bricks. The Industrial Revolution in Europe saw the beginning of the ever increasing use of fossil fuels leading to its current massive scale. It was estimated that in 1992 the annual world primary fossil energy consumption (oil, coal and gas) was 9.4 TW which is 75 per cent out of the total primary energy consumption of 12 TW (Alexander 1996). People in industrialised countries became dependent on coal, oil and gas for the supply of electricity, heat and mobility. Initially, environmental consequences of burning large volumes of fossil fuels were not fully perceived and were passing largely unrecognised. Two oil crises in the 1970s brought to the fore the economic need for a more efficient use of energy. At the same time the ever more apparent environmental damage caused by fossil fuels generated a growing interest both in reducing air pollution and finding new ways of generating energy not relying on fossil fuels, among increasingly environmentally sensitive populations of these countries.

1.2 Fossil Fuels – the Cause of Environmental Problems

Fossil fuels such as coal, oil, peat and natural gas are naturally occurring carbon or hydrocarbon fuels that were formed by partial decomposition of prehistoric organisms. Burning fossil fuels can lead to air pollution at the local, regional and

global levels. The most serious pollutants at the local and regional level, causing acid rain are sulphur oxides (SO_x) and nitrogen oxides (NO_x). Carbon dioxide (CO₂), on the other hand, is a major cause of the enhanced greenhouse effect that leads to global warming (IPCC 2001). The 'greenhouse effect' is a natural phenomenon that keeps the Earth warmer than it would otherwise be. It is caused by naturally occurring greenhouse gases such as water vapour (H₂O), carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), ozone (O₃) and human made greenhouse gases such as chlorofluorocarbons (CFCs) and their variants (Beukering 1996). However, industrial and agricultural activities have contributed to significant increases of most of the naturally occurring greenhouse gases. For instance, the concentration of atmospheric CO₂ has risen by 25 per cent since the Industrial Revolution (Beukering *et al.* 1996). The Intergovernmental Panel for Climate Change¹ forecasts that the average surface temperature will globally increase by 1.4 to 5.8°C over the period 1990 to 2100 (Blackmore *et al.* 2003).

1.3 Common Future - Common Action

In 1987 the United Nations' World Commission on Environment and Development published a report *Our Common Future* (World Commission on Environment and Development 1987), also known as the Brundtland Report after the chair of the Commission, Norwegian politician Gro-Harlem Bruntland. Among other issues, it also deals with the possible consequences of climate change and calls for action before it is too late (Beukering *et al.* 1996). In 1987, the World Commission organised in Toronto, in co-operation with the government of Canada, the Conference

¹ The Intergovernmental Panel for Climate Change (IPCC) was established in 1988 by the World Meteorological Organisation and the United Nations Environmental Programme. IPCC

on the Changing Atmosphere in which 300 leading world experts participated. The main outcome of the conference was a recommendation to governments to set as their initial goal in combating global warming the reduction of their CO₂ emissions by approximately 20 percent by 2005 against the baseline year of 1988.

At the United Nations' Conference on Environment and Development in Rio de Janeiro in 1992 almost all governments signed the UN Framework Convention on Climate Change (UN FCCC) that called for controls on the emission of carbon dioxide (Grubb *et al.* 1993). This convention also provided the legal and political foundations for international action. Subsequent emergence of growing evidence of human-induced climate change with adverse impacts gradually led to the 1997 Kyoto Protocol to the UN FCCC that defines the basic structural elements for a global action to tackle climate change (Grubb *et al.* 1999).

1.4 Renewable Energy Becomes a Part of Energy Policies

The European Union has historically been at the forefront of political initiatives aimed at reductions of greenhouse gases emissions both externally - as a proponent of global climate change diplomacy and internally - vis-à-vis its member states. The crucial importance of renewable energy sources for the European Union is endorsed in the European Commission's White Paper on Renewable Energy Sources 'Energy for the Future: Renewable Sources of Energy' (European Commission 1997). The objective of the White Paper is to double the share of renewable energy sources in gross energy consumption from approximately 6 per cent to 12 per cent by 2010.

assesses the scientific information relating to various components of the climate change and formulates strategies as a response to those problems.

Exploitation of renewable energy resources is also one of the instruments for achieving reductions of CO₂ emissions agreed at the conference of parties to the UN FCCC held in Kyoto in 1997 (Grubb *et al.* 1999). The European Union played a major part in achieving the Kyoto Protocol.

1.5 Pollution in Czechoslovakia

Although the Czech Lands are historically one the early industrialised regions of Europe, major degradation of the environment occurred mainly during the Communist period² in what was then Czechoslovakia³ (Vanek 1996). There was a sharp difference between the reaction of western countries to the perceived environmental crisis and the response among east European Communist countries, including Czechoslovakia. Until the 1970s high consumption of energy and steel was regarded as an indicator of economic development both in west and east European countries (Aron in Vanek 1996). However, partly in response to the oil crisis in the early 1970s and partly as a result of growing environmental awareness that was related to broader social changes in their societies, western countries started to reassess the link between economic development and consumption of natural resources including fossil fuels. This had as a consequence increased material and energy efficiency, which along with the application of end-of-pipe technologies reduced the impact on the environment. Due to the specific features of the economic management at the macro level, described by Kornai's concept of soft-budget constraints (Kornai 1980), communist countries were not able to achieve a similar shift. There was a common trend in the socialist economies to keep large quantities of

² The communist regime was in power in Czechoslovakia from 1948 to 1989.

³ Czech Republic was a part of the former Czechoslovakia, a federation that before the split in 1992 consisted of two republics, the Czech Republic and the Slovak Republic.

material stock to avoid shortage (Tellegen 1996). Despite the official policy of resource conservation, due to the communist managers' practice of hoarding resources on the one hand and the effort to set production targets at the lowest possible level, their centrally planned economies continued to waste resources including fossil fuels. Production units were punished by sanctions for not meeting the set targets. Hoarding, hiding the real output of the enterprise and disguising productive capacity led to chronic shortage, supply-constrained economic growth and waste (Gille 1997).

Czechoslovakia of the 1970s and 1980s, with the dependency of its heavy mechanical engineering and chemical industries on low quality lignite as an energy source, became one of the worst polluted countries in Europe. Electricity and heat for household consumption were also produced mainly from coal, particularly from lignite high in ash and sulphur. In the late 1980s the environmental crisis became more threatening than the economic crisis in Czechoslovakia (Vanek 1996). In 1989 the Czechoslovak communist regime, along with others in Eastern Europe, collapsed and the process of transition towards democracy and a market economy began. Popular environmental political mobilisation, mainly in the form of protests against severe air pollution in regions with concentrated heavy industry and electricity generation, played an important part in dismantling the Czechoslovak communist regime. In the turbulent years of the early 1990s, many people believed that the transition process opens the way also to a new and environmentally more sensitive energy policy.

1.6. Renewable Energy Resources

Renewable energy can be described as 'the term used to cover those energy flows that occur naturally and repeatedly in the environment and can be harnessed for human benefit. The ultimate sources of most of this energy are the sun, gravity and the Earth's rotation.'(UK Renewable Energy Advisory Group in Alexander 1996).

Most of the renewable energy resources are either a direct consequence of solar energy radiation such as direct solar energy or indirect, such as wind, waves and running water and biomass derived from plants and animals. The world energy demand is about 12 TW and about 10-15 per cent are provided by biomass fuels (Reddish 2003). According to the estimates of global renewable energy resources the resource base of solar radiation, wind, wave, tide and geothermal flow energy is more than 90,000 TW. The estimated resource base of biomass standing crop, geothermal heat stored and kinetic energy stored in atmospheric and oceanic circulation represents 10^{11} TW (Alexander 1996).

1.7 Biomass and the Czech Republic

'Biomass is a general term for all the biological materials on earth that originate in photosynthesis' (Reddish 2003). As a fuel it can be solid, liquid or gaseous and originates either directly from plants or from industrial, commercial, domestic and agricultural processes, sources...(Ramage *et al.* 1996). Biomass fuels or biofuels are processed in various ways to extract energy. They can be either directly combusted in their raw forms or physically processed prior to combustion. They can be also upgraded through thermochemical or biological processes (Ramage *et al.* 1996). The product of combustion of biomass is heat. Wood is a biofuel that can be combusted to

produce heat. Where its increased use, in appropriately designed apparatus, leads to conservation of fossil fuels, it is deemed to have a positive effect on the environment by improving local air quality and by reducing global emissions of greenhouse gases. For these reasons biomass as an energy resource began to be promoted in the 1980s as a part of sustainable energy policies in a number of west European countries (Olivier *et al.* 1991, Everett *et al.* 1996) and since the 1990s also in the Czech Republic (Selong 1998).

Apart from waste wood, there are also other biomass-based fuels whose potential is to various extents exploited in the Czech Republic. Waste products from agriculture such as cereal and rape straw, energy crops from poplar, willow, ash and cultivated sorrel (Uteuuaa) or hop-tree (EkoWATT 2003).

TABLE 1.1: Estimation of the Potential of Biofuels in the Czech Republic.

Type of fuel	Source	Yield [tonnes/year]
Wood, bark	Waste from forestry, wood manufacturing industry	2,600,000
Straw from cereal crops	25 per cent of the total crop of straw at crop yield of 4 tonnes/hectare	1,600,000
Straw from oil-bearing plants	Up to 100 per cent of the total crop at crop yield of 4 tonnes/hectare	1,000,000
Grasses, Reed	From approx. 20 per cent of sustained plantations at yield of 4 tonnes/hectare	800,000
Wood chippings, packing materials and combustible munipicle waste	Waste wood and wrappings	600,000
Field wood and energy cereal	Specially cultivated on land zoned off from land for production of food	4,000,000
Total until year 2010-2020		10,600,000

Source: EkoWATT (2003).

The amount of biomass, majority of which was wood used as a fuel was 1-1.5 million of tonnes per year between 1991 and 1999 in the Czech Republic. EkoWATT (2003) also estimates that the consumption of biomass as a fuel could grow up to 5 – 6 millions of tonnes per year between 2001 and 2010.

On paper at least, the use of wood as a domestic fuel should have a bright future in the Czech Republic. Wood was traditionally widely used as a fuel since it has always been relatively plentiful. One third of the country's territory is still covered by forests

that are scattered quite evenly around the country. Forestry is a large industry in the Czech Republic. It produces about 15 million cubic metres of wood annually (Ministry for Agriculture 2001). Forestry as well as wood manufacturing industry produce wood waste that, if not used for other purposes, can be combusted to generate heat. Despite the arrested development of Czech industry during the communist period, Czech society has more than a century long industrial tradition and due to the communist regime's emphasis placed on scientific and technical education, technical innovation is perceived by many Czechs as the main route to social progress. Furthermore, there are many areas in the Czech Republic that due to the concentration of fossil fuel based industries were a major source of not only greenhouse gases, but also of severe local and regional air pollution. My research, as presented in the subsequent chapters of this dissertation, examines the extent to which these tentative assumptions indicating a strong case for the spread of use of wood as domestic fuel were fulfilled in reality during the decade or so since the fall of the communist regime. The dissertation concludes by suggesting several changes to the way in which wood is promoted and utilised as a domestic fuel in the Czech Republic. I believe however, that at least some of these findings are not solely country-specific and have a wider applicability outside of the Czech Republic.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

In theory, the Czech Republic exhibits many features that make it an ideal case for a rapid and smooth spread of wood burning as an innovative and environmentally beneficial approach to household heating. Yet at the time of my research this was patently not the case. Large areas of the country had suffered in recent past severe environmental damage arising from the use of fossil fuels. Prices of fuels commonly used for domestic heating such as coal, electricity and gas soared and created an opportunity for wood as a more affordable alternative. With the integration of the Czech Republic in the European Union from May 2004 – a major proponent of renewable energy - wood as a source of domestic heating may have a chance to become more widespread. Thus the main objective of this research was to identify barriers to a wider use of wood for heating generation in Czech households. If they can be determined, it may then be possible to suggest measures that would eliminate these barriers or at least diminish their impact. However, this is clearly a challenge that goes beyond research presented in this dissertation.

An obvious start for my investigation was to look at the available Czech literature sources on the use of wood as for heating in households. In the mid-1990s when this research started the Czech literature addressed the theme of wood as an energy resource in highly technical terms of wood's availability, analyses of its heating properties and technical nuances of the functioning of combustion technology. The main focus of attention was, however, on forest management and wood production (Poleno 1994; Ministry of Agriculture and Forestry of the CR 1998). As far as the technical side of the use of wood as a fuel was concerned, detailed research was

undertaken into thermal degradation of wood (Chovanec 1992), the technology of preparation of the fuel and economics of wood combustion (Simanov 1993). However, people's decisions on the use of a particular heating method are also determined by other factors than those purely technical such as wood availability and methods of its combustion, however fundamental they may be.

It appears that to identify the barriers impeding the development of wood-based household heating generation in the Czech Republic requires investigation in four broader areas. The first area is constituted by the physical or material fuel-related conditions for the development of this type of energy, such as the availability of the fuel including financial considerations. The second level is the area of technology – the availability, efficiency, environmental impact and affordability of wood burning technology appropriate for the use at the household level. The third important area that needs to be considered is the behavioural level related to individual users' willingness and ability to embrace a new method of household heating. Individuals may have various motivations for deciding to use wood as a source of heating. Whether they are economic, environmental or related to social status, their preferences and choices will always be largely determined by government approaches and policies that in turn reflect domestic and external, in the Czech case most obviously EU related, interests. Czech government and EU policies and programmes for wood as renewable energy source are the fourth area of my investigation.

Efficient use of wood as a renewable energy resource primarily depends on the local availability of wood and a suitable and environmentally friendly technology for its combustion. The positive impact on the environment is an important feature of the

biofuel technologies that are promoted as a part of renewable energy policy of the European Union (European Commission 1997). Modern appliances used for combustion of wood at the household level represent a technological innovation whose environmental impact is examined in part 2.2. Switching to an efficient and environmentally friendly renewable source of energy is an important part of the shift to sustainable consumption. Such behaviour may involve a change in a life style (part 2.3). Various European countries promote renewable energy resources including biofuel technologies (part 2.4). Research objectives and development are in part 2.5.

2.2 Renewable Energy Resources, Biomass and Wood

The crucial importance of renewable energy sources for the European Union is expressed in the European Commission's White Paper on Renewable Energy Sources 'Energy for the Future: Renewable Sources of Energy' (European Commission 1997). Exploitation of renewable energy resources is also one of the instruments for achieving reductions of the green house gas emissions agreed at the Kyoto conference in 1997 (Grubb *et al.* 1999). The objective of the White Paper is to double the share of renewable energy sources from approximately 6 per cent to 12 per cent by 2010.

In the European Union, biomass provides 3 per cent of consumed energy (Chartier *et al.* 1998). It is 53 GW, 90 per cent of which is derived from forestry resources (Chartier *et al.* 1998). However, the potential of biomass in the European Union is greater. It is estimated to be about 173 GW which represents two thirds of the current oil production in the North Sea. Of this 66.5 GW could be derived from forestry and almost 40 GW from energy crops and plantations (Chartier *et al.* 1998).

Biomass is mostly used in thermal applications. Combustion of biomass, however, causes pollution if the process of combustion is not complete. Harmful pollutants can be released in flue gases, such as nitrogen oxides (NO_x), volatile organic compounds (VOCs), carcinogenic polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) (Launhardt 1998; Cowburn *et al.*, 1998; Koutsky *et al.*, 2002). In 1996 the European Commission launched a project within the framework of the JOULE III Programme called 'Newly Designed Wood Burning Systems with Low Emissions and High Efficiency'. Its goal was to lower the emissions caused by domestic stoves combusting biomass (Hyytiäinen 1998).

Emissions of pollutants relating to wood burning furnaces are usually a consequence of incomplete combustion. New technologies, however, are able to achieve low emissions (Launhardt 1998). The same author analysed pollution caused by combustion of untreated wood (Launhardt 1998). He compared several appliances designed and used for combustion of wood. He found out that PCDD/F were formed in detectable quantities by combustion of natural untreated wood in domestic furnaces. Environmental performance of wood burning appliances of different designs was also researched by Cowburn and his colleagues (Cowburn *et al.* 1998). Carno *et al.* (1996) examined the ways in which emissions of VOCs (volatile organic compounds) from small wood burning heaters can be lowered through the improvement of catalytic oxidation.

2.3 Changing Life Style

Using wood as a renewable energy resource by individuals is theoretically a form of sustainable consumption. The design of the technology used for efficient combustion of wood has to agree with the legislation so that it burns wood efficiently and does not cause environmental pollution. The way the technology is used depends to a great extent on the consumer. It means that the consumer chooses the quality of a fuel and the way the wood burning appliance is managed. However, consumers are usually not identified as responsible for environmentally damaging effects of their consumption practices (Murphy *et al.* 2001). The design of more efficient household appliances is the producers' responsibility and there has been little thought or effort to regulate consumption itself in order to address environmental problems (Murphy *et al.* 2001). However, after the 1992 Earth Summit,¹ consumption is starting to be viewed as a legitimate domain for environmental policymaking. Policymakers form opinions about consumers according to the information that is available to them. The world-views of economists and technologists are dominating consumption related behaviour (Murphy *et al.* 2001). In this dominant conceptualisation, policies addressing consumption are derived from the premise be that people act as autonomous beings that are not influenced by other consumers when making consumption decisions. They are also regarded as rational consumers who focus their attention only on maximising their personal welfare. Murphy *et al.* (2001) also point out that there is also a common assumption that originates in the economist's perspective of the well functioning market which is that consumers' demand for goods responds to

¹ The 1992 Earth Summit in Rio de Janeiro that formulated Agenda 21 whose Chapter 4 was devoted to consumption.

information and price. In order to work efficiently, the price on the market has to be right and information has to be readily available.

Switching from other fuels to wood as a renewable energy resource to obtain environmental benefits involves a change in behaviour and a change in a life style. Individuals decide about environmental issues as individuals concerned with the environmental issues at hand, as consumers and as citizens (Blackmore 1997). People have different values in relation to each of these roles (Sagoff 1989). The factors influencing behaviour can be disclosed through a theory of reasoned action (Fishbein 1975). According to this theory, the immediate antecedent of any behaviour is the intention to perform the behaviour in question (Fishbein 1985). Hobson (2001) argues that the formation of attitudes is more complex than expressing one's beliefs and stresses the importance of argumentative aspects of social life. Hobson (2001) finds it is essential that people who make decisions about their switch to a more sustainable life-style need to participate in debates about sustainable life styles with themselves and others in order to understand the change and they can do it through environmental communication programmes.

The extent to which the public is receptive to calls to change aspects of their everyday behaviours for the sake of the environment is discussed by Harrison *et al.* (1996). The discussion is based on a study of the extent to which ordinary citizens feel a lack of agency and/or an unwillingness to assume greater personal responsibility for effecting pro-environmentally friendly behaviours. As far as a focus on changing people's behaviour is concerned, Harrison *et al.* (1996) point out that efforts to change people's behaviour towards a more environmentally friendly

behaviour rely on advertising campaigns and target projects within selected communities.

Danielsen *et al.* (2001) point out the important role of non-economic motivations for introduction of renewable energy resources. Non-economic motivations include ecological motivations, community action, co-operation and independence. A local initiative or at least strong involvement of local people were, according to Danielsen *et al.* (2001), of utmost importance for the introduction of renewable energy technologies. Although their research related to biomass district heating in Austria (Danielsen *et al.* 2001), they pointed out that:

‘existing bottom up initiatives in a local community can be an element that strongly facilitates the introduction of renewable energy technology. In Austria, for example, the majority of biomass projects occur in villages where people get involved in the community’s life: the probability to find bioenergy project in a village with cultural initiative is 8 times higher than in a village without such an initiative.’

Danielsen *et al.* (2001) also stressed that the success was the result of the combination of bottom up initiative and top down support. This is also in agreement with Brohman’s opinion that sustainable energy strategies should generally favour bottom-up over top-down approaches. Brohman also argues that projects that lead to sustainable development should be designed with extensive public participation. This applies particularly to smaller projects rather than mega projects (Brohman in

Roseland 1998) because sustainable development must be also participatory development (Gran in Roseland 1998).

2.4 Promotion of Biomass as a Renewable Energy Resource and Government Policies

At the end of 2002, the Czech Republic was invited along with other seven applicant countries to join the European Union in May 2004. This implies a full adoption of *acquis communautaire*² of Union by the Czech Republic by the date of accession. This also applies to the Sixth Environment Action Programme (2001 – 2010) which is, for the first time in the history of EU environment action programmes, a legally binding document. As the Sixth Environment Action Programme mentions in its proposal for a Decision of the European Parliament and of the Council actions will be taken to empower citizens and change their behaviour (Commission of the European Communities 2001). The same document states that ‘under the Aarhus Convention, the Community Member State institutions have signed up to a series of commitments regarding improved transparency, access to environmental information and public participation in environmental decision making.’ This requires revisions in community legislation. In order to be able to exercise their power, people need to recognise the complexities of environmental issues, how they could be resolved and how the citizens could contribute to their resolution. Furthermore, the document also states that:

² The entire body of European law. The term is most often used in connection with preparations by the 12 candidate countries to join the union. They must adopt, implement and enforce all the *acquis* to be allowed to join the EU. For enlargement negotiations, the *acquis* have been divided into 31 chapters, each of which must be ‘closed’ by the candidates. Available from http://news.bbc.co.uk/1/hi/in_depth/europe/euro-glossary/1216329 [Accessed 9 April 2003].

‘(I)nformation for citizens, aimed at encouraging more sustainable lifestyles, is probably best provided at local, regional and national level and by a range of organisations, from the government to NGOs, which command respect and trust. Practical information is needed that helps people to use and buy alternative products and services that are energy efficient, recyclable or otherwise environmentally benevolent. The Community can help encourage the spread of this sort of activity through information on the best practice and practical tool-kits aimed at kick starting action by local authorities or other organisations.’

The document also demands that consumers should be able to make informed choices to which end they need access to relevant information. The governments should also set up appropriate mechanisms for monitoring self-declared environmental claims related to the Directive on Misleading Advertising.

The document stresses the importance of the business community’s involvement in actions aimed at the improvement of the environment. Among other measures, an action should be taken on ‘economic incentives for environmentally friendly products, enhancing “green” demand through better consumer information, developing an objective basis for green public procurement, and action to encourage more environmentally friendly product design.’

Everett (1996) suggests that to encourage the development and deployment of renewables, the most straightforward means that governments can use is marketing

and promotional techniques, so that the potential users are fully informed of the latest technologies available, their costs and their benefits. The governments can also subsidise demonstration schemes in which working examples of renewable energy are created to convince potential users, to remove institutional constraints such as systems in which either producers or consumers of renewable energy are disadvantaged in comparison with producers or consumers of non-renewable energy. New laws should be introduced that favour the development of renewables. The use of subsidies represents a more controversial means to promote renewable energy resources, because it could be by some regarded as detrimental to the functioning of the free market and free trade in energy has long been a policy goal of the European Union (Everett 1996).

When assessing the effectiveness of government policies aimed at promotion of wood as a domestic fuel in a transitional country such as the Czech Republic, it is useful to draw comparisons with countries that, in this respect, have more experience. The UK Department of Environment publishes 'Planning Policy Guidance' notes to local authorities to help them in their assessment of specific topics. The Planning Policy Guidance 22 published in 1993 'strongly supports the concept of renewable energy development and urges Authorities to look sympathetically at proposals for the generation of power by alternative means to fossil fuels'. The guidance includes:

- advice on how local Planning Authorities should include renewable energy in their development plans;
- a recommendation that Local Authorities take account of the government's policy on renewable energy;
- an observation that renewable energy can be exploited close to the resource;

- an estimate of the contribution renewable resources can make towards reducing greenhouse gas emissions...; (Muirhead 1993 in Everett 1996).

In order to meet the Government's aim of 1,500 MW of new renewables capacity by the year 2000. The UK Department of Trade and Industry in 1993 organised seminars for Local Authorities about renewable energy's planning and environmental implications. Every Local Authority also received a new guide published by the Department 'Renewable Energy - Planning for the Future'. They also published a guide 'Financing Renewable Energy Projects' and also organised a seminar 'Renewable Energy - A Commercial Opportunity.'

In Denmark, which is well known for using straw for energy production on a large scale (and has extensive use of wind energy) (Ramage *et al.* 1996), the Danish Ministry of Energy launched in 1990 the action plan Energy 2000 in which the local politics took a new image. The plan set a number of goals to be achieved by 2005 that, if met, should reduce energy consumption, increase the use of natural gas and renewable energy, reduce the use of coal and oil and emissions of CO₂, SO₂, NO_x. Since the beginning of the 1980s commercial exploitation of oil and gas reserves in the North Sea was initiated and at the same time the excise duties on coal and oil were imposed and gradually increased. Taking these measures caused that the use of biomass for energy production became more competitive (Nikolaisen 1992). The action plan gives the Minister of Energy the power to regulate the choice of fuel for central boiler houses, district heating plants and CHP plants. The Danish Ministry of Energy provided the Danish municipalities with conditions which in detail describe what represents environmentally acceptable conversion. In Denmark, the first Energy

and Environment Offices were founded in 1970s and they create a network of local associations of citizens. They provide information on renewable energy resources and initiate activities that relate to energy generation and the environment. Citizen's associations comprise households, building societies, firms and farms. They are involved in environmental projects and are entitled to public funding. They organise exhibitions, lectures, publish newsletters on renewable energy resources (Vikkelse 1993).

The Dutch government produced its first National Environmental Plan in 1989. In 1993 the Dutch government and political parties agreed to increase consumption of biomass for energy purposes to 1.2 million tonnes of straw and 0.2 million tonnes of wood by year 2000. In 1994 the government subventions on energy related research represented 0.28 per cent of GDP (\$40.7 million). There were 14 per cent of all expenses on research allocated to measures connected with saving energy. The money spent on research moved from programmes on reducing energy use to programmes on research of renewable energy resources between 1990 and 1994. In 1990, 25 per cent of financial resources went on renewable energy projects and 20 per cent on projects for reducing energy use. In 1994 there were 44 per cent on renewables and 14 per cent on reducing energy. The Dutch government has also funded a continuous national advertising campaign to change public attitudes and behaviour towards the environment.³

In Austria the use of locally available sources of biomass is reported to save about 720 MECU a year. In some parts of Austria, such as Carinthia, for example,

renewable energies cover around a half of the province's primary energy demand (Wohlgemuth 1998). Wohlgemuth (1998) analysed a possible effective strategy for promotion of renewable energy technologies (mainly hydro-power and biomass). He analysed several indicators such as import dependency, employment, capital expenditure, carbon dioxide emissions and government decisions. In the case of Carinthia, his recommendations comprised of increasing the tax on fossil fuels in order to make renewables more competitive and increasing capital subsidies for the local decision-makers. Upper Austria generates 25 per cent of the Austria' total energy requirements, and the regional government created an energy plan in 1993 in which energy efficiency and the use of particularly biomass and solar energy are combined (Dell 1998). The plan was implemented through a regional energy agency (ESV)⁴ founded by the regional government. It is an association including regional government, utilities, professional associations, technology companies and environmental groups. They provide advice to households, public institutions and industry. They also implement projects on behalf of the European Commission within the EU and in Central and Eastern Europe (SAVE⁵ and ALTENER⁶). According to Dell (1998), the government of Upper Austria has very clear strategies for promoting energy from renewable resources. The strategy is based on providing information and creating public awareness about biomass since, 'despite the considerable market penetration, there is still a lack of awareness and know-how about where and how to

³ VROM Memorandum on Information as a Policy Instrument. AVT91, VROM, The Hague, 1991 in Harrisson *et al.* (1996).

⁴ ESV-Energiesparverband is an energy agency founded by the regional government in 1991 to promote energy efficiency and renewable energy resources in Upper Austria.

⁵ Specific Actions for Vigorous Energy Efficiency is a programme financed by the European Union, open to full and associated members, focused on increasing energy efficiency and stabilisation of CO₂ emissions, succeeded by SAVE II between 1996 and 2000.

⁶ ALTENER res. ALTENER II is a programme financed by the European Union, open to full and associated members, focuses on implementation of renewable energy resources.

use it' (Dell 1998). This part of the strategy consists of providing an Energy Hotline accessible at a cheap rate from all over Austria. Also an annual trade fair on energy efficiency is organised, informal talks and presentations are frequently held in banks, city halls and pubs, there are also frequent radio and television campaigns about successful renewable energy projects, brochures, videos, CD-ROMs and other tools on renewable energy resources are disseminated. Energy efficiency and internet information page is visited by 6,000 visitors every week. These activities, writes Dell (1998) have as a common goal 'to reach as many people as possible and make them aware about renewable energy resources.'

Austria is in many respects a similar country to the Czech Republic as regards forest cover and annual production of wood, although there is one significant difference. Many people who use wood as a fuel in Austria take it from their own forests. Among other reasons this may contribute to the fact that Austrians are more advanced in the use of wood as a fuel. Biomass provides about thirteen per cent of Austrian primary energy consumption. Sixty per cent of it comes from traditional stoves and boilers fired with wood logs. The main part of the Austrian policy and management attention is aimed at biomass district heating. In 2001 there were about 500,000 small individual systems burning wood in operation (Schmidl 2001). Nevertheless, he remarks, only 150,000 were modern, efficient and environmentally friendly technologies that have been used since 1990s. According to Schmidl (2001) the number of households using wood as a main source of heat is declining because using wood as a fuel is often understood as too labour demanding in Austria. However, it is still very popular as a complementary fuel and as a main fuel in low energy houses. He states that implementation of the modern systems, particularly the pellet burning

systems, could reduce the decline. The market for pellet boilers doubled each year in the last five years. Until now, a similar dynamic development has only occurred in Scandinavia (E.V.A. 2003).

Dell (1998) evaluated the potential of biomass for employment and found that particularly wood-based individual heating systems were very important because they were work-intensive. In last 20 years, says Dell, 10,000 - 15,000 jobs were created or maintained in forestry and in the production and installation of biomass systems. Also Rakos (1998), for instance, recognised importance of individual heating systems and called for 'extending the scope of renewable energy policies to individual heating with wood.'

2.5 Research Plan

2.5.1 Research Objectives

The preceding review of literature supports the idea that wood fuel could be a useful contribution to the Czech situation. The large area of the Czech Republic that is covered by forests suggests that there is a potential resource present. In the mid-1990s new, modern and environmentally friendly boilers for individual purposes appeared on the Czech market. This suggested that it was important to establish if there are suitable conditions for use of wood as a renewable energy resource in the Czech Republic, whether it could significantly contribute to generating of heat and if yes what are the major obstructions to its widespread use.

If wood is to be used by the general public as an environmentally friendly renewable energy resource, two basic physical and technical conditions have to be fulfilled. It

was necessary to determine (a) whether there was enough wood available for significant use as fuel and (b) accessible technology that burns wood efficiently and does not pollute the environment. Once these two requirements were established, the aim of this research became twofold. The first goal was to determine which factors and influences play a significant role in the process in which individuals make their decision about the use of wood as a renewable fuel. The second goal was to establish the extent to which Czech government's policies address issues associated with a possible shift to renewable energy. The underlying idea was that the identification of policy failures can lay ground for the formulation of possible remedial actions. It could also enable me to assess the extent to which the use of fuel wood as an energy resource in the Czech Republic makes a positive contribution to a broader shift towards renewable energy.

2.5.2 Development

The research involved firstly a literature search to establish the extent of existing work in this area of research. Subsequently, pilot questionnaire was issued to some users of fuel wood in North Bohemia in order to determine their experiences and attitudes to fuel wood. Lastly, analysis of the government policy, its implementation and enforcement was carried out. Experts and policy makers were interviewed.

CHAPTER 3: POLITICAL AND REGIONAL STRUCTURES OF THE CZECH REPUBLIC

To set the research in context, a brief outline of the governmental structure of the Czech Republic is provided below. Parliament consists of a 200-member Chamber of Deputies and an 81-member Senate. Executive power is exercised by the prime minister, and the president is elected by parliament for a five-year term. The general election in June 2002 enabled the formation of a coalition government consisting of three parties - the Czech Social Democratic Party (CSSD), the Christian Democratic Union-Czechoslovak People's Party (KDU-CSL) and the Freedom Union (US). The government's main task in 2002-3 is to prepare the country for the upcoming to the European Union accession due in May 2004. This will require wide-ranging legislative and administrative reforms.

3.1 Structure and Operation of Municipalities, Districts and Regions in the Czech Republic¹

Municipalities are the basic territorial self-governing units and regions are the higher territorial self-governing units. These bodies own property and financial funds that they manage independently. Municipalities also exercise state administration in the field determined by the law.

The local council is the basic body of the municipality, with members directly elected by citizens. The council is the main decision-making body. The board is the executive

body. The mayor (in municipalities)/president (in regional councils) is elected by the council. Powers of municipalities are regulated by the Act on Municipalities and by separate laws. Within the sphere of its independent jurisdiction, the municipality deals with matters that are important to the municipality and its citizens, unless they are assigned by law to regions or they involve delegated jurisdiction by a special law. The independent jurisdiction of the municipality among others includes approving the programme of development of the municipality's territorial ward and approving the municipality's territorial plan and regulation plan.

Co-operation of municipalities is defined by law. An association of municipalities may be established for several purposes. One of them is to fulfil tasks in the field of air protection, tasks relating to conversion of heating or water-heating systems based on fossil fuels into systems using environmentally more suitable sources of thermal energy in residential or other buildings owned by municipalities. An association of municipalities may be also established to manage their own forests.

The independent jurisdiction of regions includes for example co-ordinating the development of the region's territorial ward according to special laws, ensuring their implementation and controlling their fulfilment. It also includes approving territorial planning documentation for the region's territory and announcing binding parts of such documentation through a generally binding decree of the region.

There are fourteen regions in the Czech Republic. They co-operate closely with municipalities when exercising their own duties. Regional authorities shall always

¹ The main source of information on governmental structure in the Czech Republic is Council

consult them on issues of regional development which are of concern to municipalities bodies. Regions can freely co-operate within the scope of their own competence. One form of co-operation is obligatory, when regions create a special council of cohesion in the territory of NUTS II (for explanation of NUTS see Appendix I). This is particularly relevant for co-operation aiming at implementing projects which come under the pre-accession funds of the European Union and in the future European Structural Funds and setting up Regional Operational Programmes.

District offices carry out the state administration of districts. The state administration at this level will be terminated by the abolition of district offices, which was scheduled for 31 December 2002. After that, their state administration competencies is transferred to 170 - 210 authorised municipal offices. These larger offices perform state administration on behalf on smaller communities in the territory.²

3.2 Grants from Higher Authorities

In recent years, the state budget and the budget of the State Fund for the Environment has provided specific grants to budgets of district offices and municipalities. In 1999 the proportion of total grants to total revenue of local authorities was 23.3 per cent. Some types of specific grants, which are provided to municipalities mainly from the budgets of central administration authorities, are provided only if an entity receiving such grants uses its own financial resources too. This includes programmes that contribute significantly to the development of municipal infrastructure such as

of Europe (2001).

² Precise nomenclature of all Czech regions and districts is in Appendix I

investment actions that are connected with environmental protection and are financed from the budget of the State Fund for the Environment.

For the implementation of investment actions relating to environmental protection, municipalities can take loans from the budget of the State Fund for the Environment.

The following names relating to the area which is now known as the Czech Republic are used throughout the thesis:

Czechoslovakia was established on 28 October 1918 and ceased to exist on 31 December 1992. Since the late 1960s it was a federal state consisting of the Czech Republic and the Slovak Republic. The Czech Republic is the current official name of the country that only geographically divides between the three historical lands: Bohemia, Moravia and Czech Silesia (nine tenths of the historical Silesia are in Poland). These three historical lands are known as the Czech Lands.

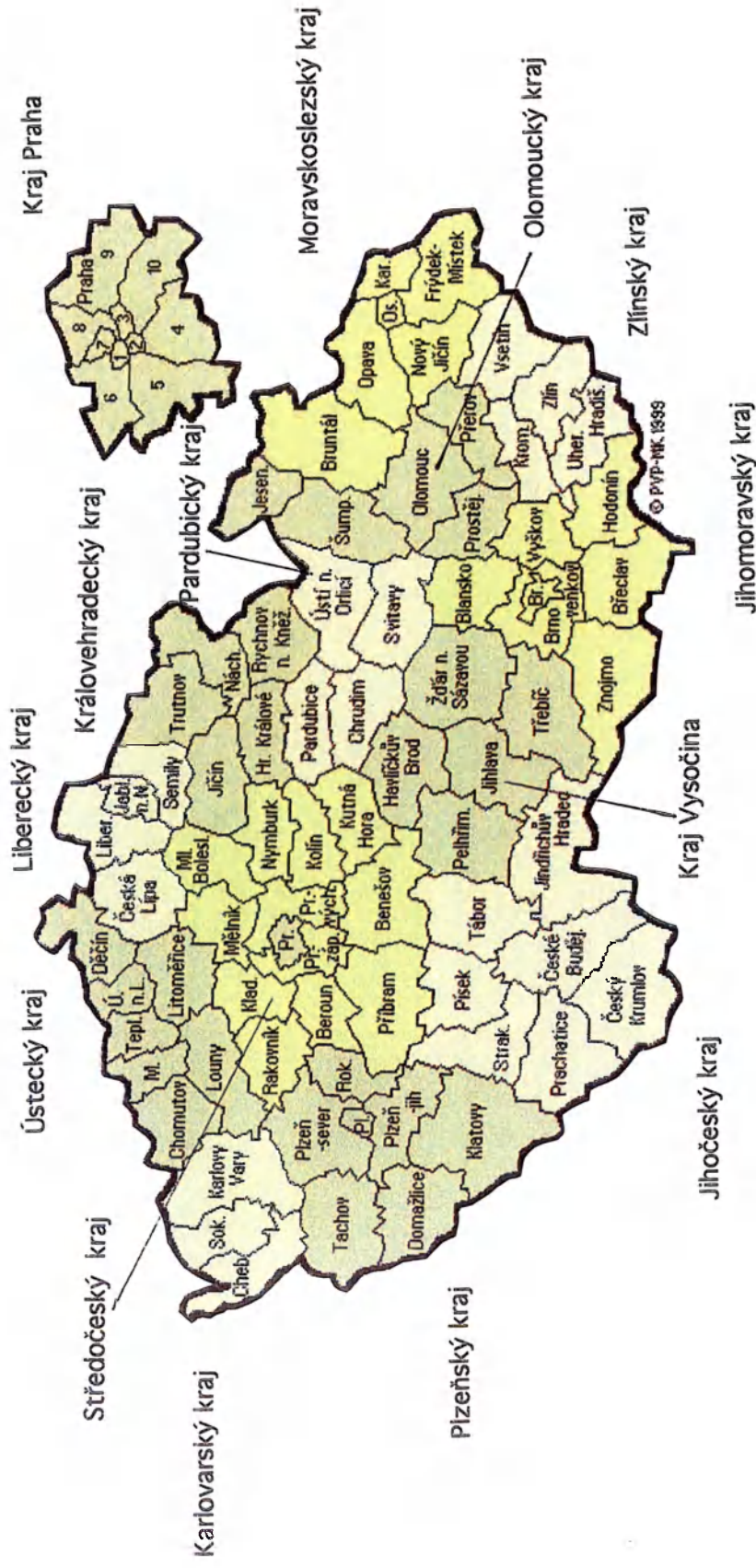
The Czech Republic*

Area: 78 866 sq. km



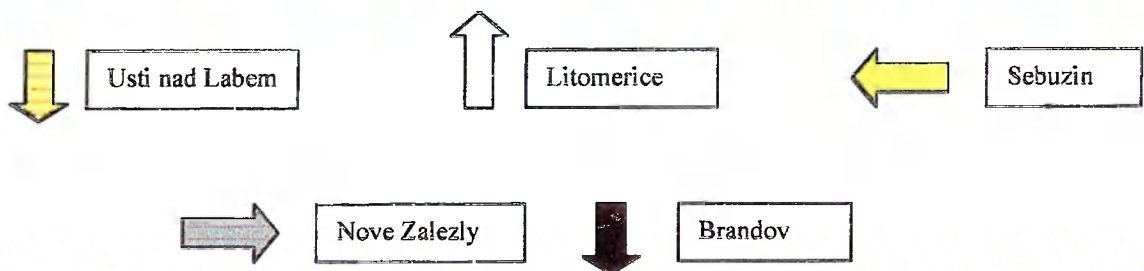
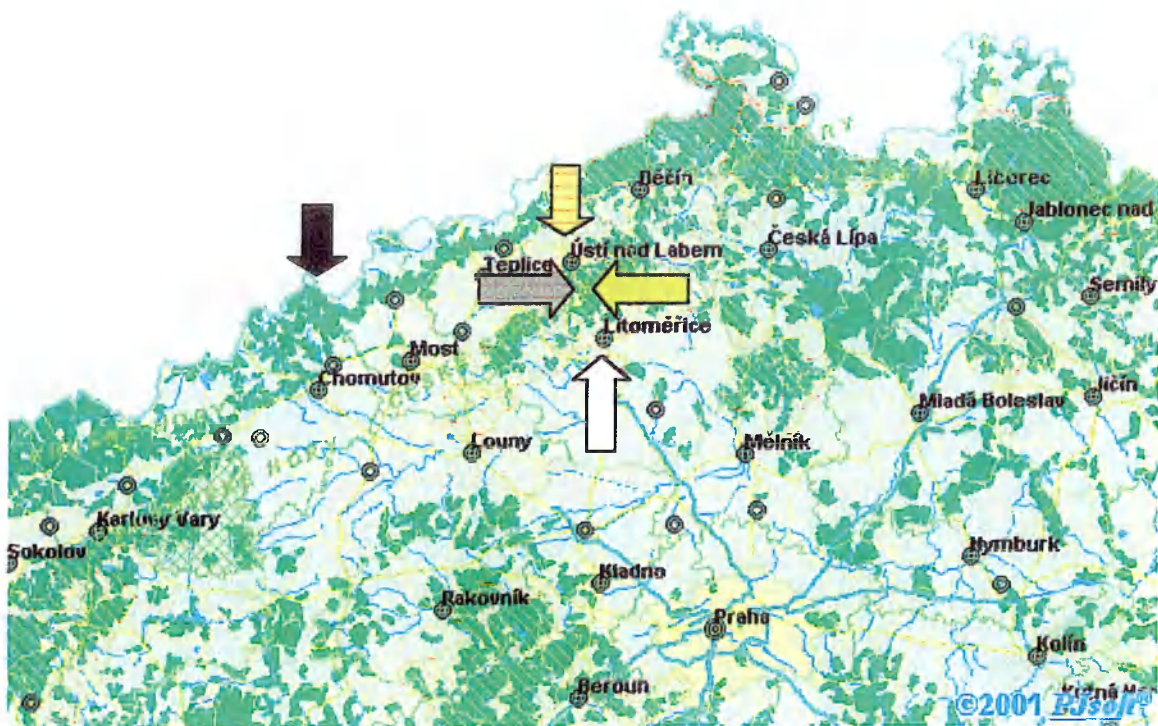
* <http://www.cia.gov/cia/publications/factbook/geos/cz.html>

Regions and districts in the Czech Republic*



* <http://www.beer-kozel.cz/pvp09c.htm>

Map showing the municipalities where the pilot survey took place¹



¹ Based on a map taken from <http://www.seznam.cz/mapy>

CHAPTER 4: AVAILABILITY OF WOOD

4.1 Introduction

Availability of wood is the most basic criterion that has to be considered when the potential for the conversion of households to this renewable source of fuel is assessed. Hence the aim of this chapter is to look at the indicators of the amounts currently available and to establish whether the forest cover in the Czech Republic can be seen as a long-term stable and sufficient source of the wood as a fuel. I first take a look at general long-term and more recent trends in forest management in the Czech Republic. This provides a background for a more detailed assessment of the potential of sustainably harvested wood in a selected region of the country. I start off by analysing the changes in the extent of the forest cover in the Czech Republic in the past (part 4.2). Expected future trends and their determining factors are also discussed in this part of the chapter Part 4.3 looks at the amount of wood produced in the Czech Republic. It is followed by an outline of the legal basis for forest management and forest protection in force in the late twentieth century (part 4.4). The subsequent part 4.5 of the chapter attempts to estimate how much sustainably obtained fuel wood is available in the Black Triangle region, where I conducted my empirical research on the use of wood as a source of domestic heating. Finally, I discuss what proportion of households in that region could be supplied with sustainably obtained fuel wood.

4.2 Changes in Forest Coverage

More than 33 per cent of the whole area of the Czech Republic is covered by forest. In 2001, forests covered 2,638,917 hectares of the country, out of which forests

managed for commercial purposes represented 76.3 per cent (Ustav hospodarske obnovy lesa 2001) The average forest cover in member states of the European Union in 1997 was 33.4 per cent.¹ In order to better understand the current availability of fuel wood in relation to near future expectations I decided to look closely at the history of forest husbandry. Historically, forest was the dominant landscape formation in the Czech lands and although the Middle Ages witnessed a considerable reduction of the forested territory, forest nevertheless remained a significant feature of the Czech landscape over the past two centuries. Table I shows that the area of Czech forests has not significantly changed during the last 200 years and that the area of forest has been growing during the last 100 years or so.

TABLE 4.1: Changes in Forest Coverage as a Percentage of the Whole Territory of the Czech Lands/Czech Republic.

	Czech Lands			Czech Republic		
Year	1790	1865	1910	1985	1994	2000
Forest (percentage)	25	28	30	33.3	33.3	33.4

Source: Ministry for Agriculture of the Czech Republic (1995); Ministry for Agriculture of the Czech Republic (2001).

With a respect to quantity, this stability clearly took place as a consequence of a centuries-long tradition of forest husbandry policy. Records about directives trying to balance the amount of felled trees with afforestation of clearings go as far back as the

¹ Britain, for example, with 2.8 million hectares of forest, has approximately 0.05 hectare of forest per capita while in the Czech Republic the same indicator is approximately 0.25 hectare per capita.

fourteenth century (e.g. *Majestas Carolina* from 1348). First recorded forest husbandry plans date back to the eighteenth century. Many aristocrats - owners of forest, who had an interest in good forest management - commissioned forest husbandry plans. First they had to turn for inspiration abroad and later, when the first schools for foresters were founded in 1773 in Blatno and in 1795 in Zlatá Koruna and a central office for administration of state forests was established, they could have them developed by locally trained experts. A statutory order was issued by the Court Chamber in 1919 which specified how a forest husbandry plan should be conceived. Through this means, the state sought to force forest owners, and owners of small forests in particular, to improve the conditions of their property. Since then a number of further instructions concerning topics such as management of the property, protection of forests, husbandry and inventory of forests were issued. They gradually became an obligatory requirement for all ownership groups (see Table 4.2). Since the 1960s, all owners have been obliged to run their forests according to 'obligatory management plans' (Table 4.3).

TABLE 4.2: Types of Forest Ownership on the Territory of Today's Czech Republic 1850 – 1998.

Year	Forest (percentage of total area)								
	State	Municipal	Church	Voluntary co-ops ¹⁾	Foundation ²⁾	Nobility	Other private	Forced co-ops ³⁾	Restitution in process ⁴⁾
1850	2.5	9.1	8.0	-	1.7	21.0	57.7	-	-
1900	0.3	9.3	6.7	1.0	0.7	28.7	53.3	-	-
1930	12.4	11.3	7.1	1.8	1.2	-	66.2	-	-
1945	18.3	14.9	6.1	1.7	0.9	-	58.1	-	-
1947	60.1	17.4	7.1	3.2	-	-	12.2	-	-
1950	70.1	16.6	-	3.2	-	-	10.1	-	-
1990	95.8	-	-	-	-	-	0.1	4.1	-
1994	68.6	10.5	-	0.0	-	-	14.9	0.0	5
1998	63.4	12.8	-	0.8	-	-	23.0	-	-

1) Voluntary co-ops were associations of private owners of forests.

2) Foundation forests were a property of foundation farms and served as financial resources for certain individuals such as aristocrats, war invalids, priests or students. They were abolished in 1918.

3) The result of forced collectivisation of property of private farmers.

4) As a result of the Restitution Act some of the formerly collectivised property is given back to its former owners.

Sources: Adapted from: Ministry for Agriculture of the Czech Republic (1995); Ministry for Agriculture of the Czech Republic (1998).

TABLE 4.3: Forest Management Plans.

Year	Forest management plans in percentage of the total area of forests	
	Areas with implemented Obligatory Management Plans	Existing management plans
1850	3.0	55.0
1900	46.7	72.5
1930	80.6	76.9
1950	90.2	90.2
1990	100.0	100.0
1994	100.0	100.0

Source: Ministry for Agriculture of the Czech Republic (1995).

4.3 Felling of Trees in Czech Forests

According to the statistical data based on forest plans, there has been a growing trend in felling since the end of World War II. Nevertheless, the rate of felling has never exceeded forests' regenerative capacity (Klvacova 1997). According to the Report on Forestry in the Czech Republic, the total felling should come near the total increment in order to maintain balance. In 2001 estimated felling were approximately 15 million cubic metres (1.4 cubic metres per capita in the Czech Republic). In the same year the mean annual increment represented 17 million cubic metres. (Ministry for Agriculture 2001).²

The post-1989 development that has brought, among other things, a change in ownership of forests did not result in any significant changes in the rate of felling (Table 4.4). The estimated increment of trees in Czech forests (Table 4.5) has not changed either. The stock of wood was 250 cubic metres per hectare of forest in 2001, which was twice as much as in 1930.

TABLE 4.4: Total Annual Felling and Random Felling of Coniferous and Deciduous.

	Total			of which random felling ¹⁾			
	Conife- rous	Decidu- ous	Total	Conife- rous	Decidu- ous	Total	
1962	7 964	665	8 629			1 950	22.6
1970	8 798	1 304	10 102			3 174	31.4
1980	12 198	1 428	13 626	6 801	259	7 060	51.8
1990	12 175	1 157	13 332	9 359	463	9 822	73.7
1994	11 157	793	11 950	8 951	331	9 282	77.7

² Volumes are given in cubic metres under bark with minimum top diameter 70 mm.

1) Random or 'salvage' felling means cutting of damaged trees as a consequence of calamities or pest infestations.

Source: Adapted from Ministry for Agriculture of the Czech Republic (1995).

TABLE 4.5: Intensity of Felling in the Post-1989 Period.

Total Annual Felling			
Felling	1999	2000	2001
Coniferous in millions of cubic metres	12.42	12.85	12.68
Deciduous in millions of cubic metres	1.78	1.59	1.69
Total	14.20	14.44	14.37
Total per capita (in Czech Republic) in cubic metres	1.37	1.41	1.40
Per one hectare of forest land	5.39	5.48	5.45

Source: The Czech Statistical Office and Ministry for Agriculture of the Czech Republic (2001).

TABLE 4.6: Mean Annual Increment.

Year	Mean Annual Increment	
	Total (million cubic metres without bark annually)	Per hectare of forest stands area (cubic metres without bark annually)
1880	6.9	3.0
1900	7.2	3.1
1930	7.4	3.1
1950	7.5	3.0
1990	9.5	3.6
1994	9.5	3.7

Source: Adapted from Ministry for Agriculture of the Czech Republic (1995).

Until the mid-1990s a growing number of random or 'salvage' felling was recorded (Table 4.4). It was regarded as a consequence of an improper mixture of species in some forests on the one hand and of the origin of some of the planted species on the other. At the beginning of this century, fast growing unsuitable spruce trees were planted in areas previously infested by pests in order to replace the vegetation quickly. They were often grown in inappropriate locations including too high altitudes. Another reason for salvage felling was a neglected maintenance of the trees after 40 - 50 years of their growth which 30 years later resulted in their reduced resistance against effects of wind and snow. Forest wind and snow damage also partially caused by extreme weather conditions that periodically occur in the Czech mountains. Salvage felling that comprise dead, dying and damaged trees represented more than a half of all felling in the Czech Republic in some years. From the forest managers' point of view, this situation was very worrying and according to some opinions could lead to a break-up of forest ecosystems in large areas of the country within a time horizon of one generation (Mikula 1997). However, the trend in salvage felling has been declining since the mid-1990s. As opposed to the early 1990s, when salvage felling accounted for 30 to 60 per cent of the total felling, only 15 per cent of the total number of felled trees in 2001 were salvage felling.

The Ministry for Agriculture has a long-term policy to subsidise the process of replanting of trees. The share of deciduous trees increased from 12.5 to 22.5 per cent between 1950 and 2001 (Ministry for Agriculture 2001). Forest cover, forest area, annual increment per one hectare and felling in Czech forests are comparable with Germany, Switzerland and Austria (Ministry for Agriculture 1995). According to Mikula (1997) from the Ministry for Agriculture, the figures representing the total

annual felling of 10 million cubic metres were below the calculated felling capacity of Czech forests.

However, recorded unauthorised felling discovered by the State Forest Administration (Statni sprava lesu - SSL) and the Czech Environmental Inspection (Ceska inspekce zivotniho prostredi - CIZP) have a noticeable and persistent negative impact. In 1998, for instance, 538 cases of unauthorised felling were revealed which represented 111,000 cubic metres of wood (Ministry for Agriculture 1998).

TABLE 4.7: Recorded Unauthorised Felling 1998 – 2001.

Recorded unauthorised felling		
Year	Number of cases	Timber volume (thousands of cubic metres)
1998	538	111.0
1999	720	152.4
2000	669	148.1
2001	585	112.9

Source: Ministry for Agriculture of the Czech Republic (2001).

4.4 Comparison of Some Aspects of Legal Protection of Czech Forests in the Late Twentieth Century

Czech forests are protected by forest acts. Three important forest acts were in force in the second half of the last century. These were the Forest Act 166/1960 from 1960, Forest Act 61/1977 Coll. from 1977 and the latest Forest Act from 1995.

As far as environmental considerations were concerned, the 1960 Act obliged the users of forests to manage them so that the fertility and production would increase

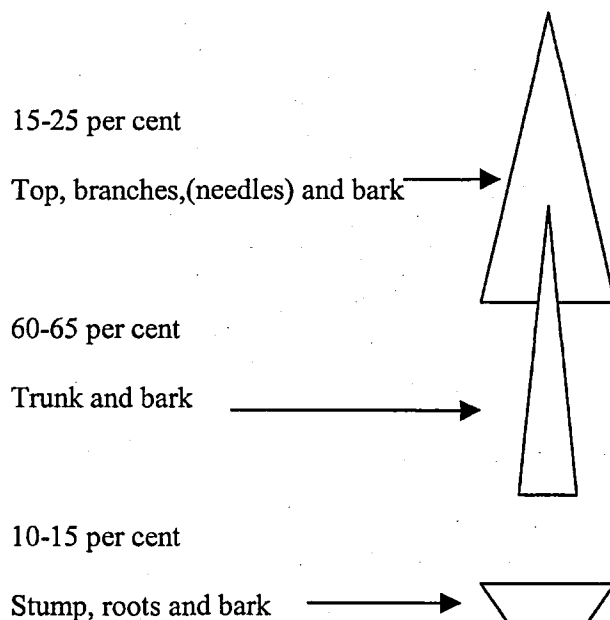
and at the same time it would not endanger other functions of the forest such as soil protecting, climatic or recreational functions. Regarding production of wood, the overall situation in the Czech forestry might be regarded as very stable and under a firm control of the state authorities. According to its critics (Blaha 1996), the latest Forest Act which was passed by the Czech Parliament in autumn 1995 is a continuation of the policy of taking forest primarily as a source of wood with a little regard to its other, non-production functions. These functions, however, could consequently have an important impact on production of wood. For example, insufficient attention is paid to the need to replace currently dominant monocultures in which trees are weaker and prone to both biotic and abiotic damage that subsequently leads to salvage felling. In another critical remark Blaha (1996) pointed out that 'neither the delegates of forest joint-stock companies, nor other entrepreneurs expressed any complaints when the Act was on the agenda of the Parliament'. This could indicate that the Act met their requirements that might be good news for the availability of wood and consequently fuel wood, it could also undermine its position as an ecological fuel.

A constant increment of trees, a constant annual amount of cut trees should theoretically also mean a constant supply of available wood, including fuel wood. Nevertheless, the figures do not yet reveal what potential they represent for wood as a fuel. The majority of utilised wood is consumed by industry. As the technologies of wood processing are gradually improving the relative share of fuel wood in the total production of wood decreases so that industries using waste wood buy more wood of lower quality than they used to in the past (Simanov 1993). This factor can also have a crucial impact on local availability of fuel wood. As a consequence, it does not

necessarily mean that a consumer of fuel wood who lives close to a sawmill will have a sufficient supply of fuel wood. If there is a wood processing plant such as a paper mill or a plant producing chipboard, they may process all waste wood available so that nothing is left for household heating purposes.

According to Simanov (1993), the total *biomass* produced by a tree can be divided into the following categories: a trunk, a tree stump, roots, a top, branches and bark.

FIGURE 4.1: Division of *Biomass* in a Tree [according to Johansson and Wernius (1974) in Simanov (1993)]



Simanov (2002) claims that due to losses caused during processing of wood only between 46 and 50 per cent of the whole production of stock wood is finally used. He estimates that the same amount of wood that is produced and statistically recorded is also unused which represents a great potential for its use as an energy resource. If the current recorded fellings are approximately 14 million cubic metres a year (Table

4.5), another 14 million cubic metres of wood could be used as an energy resource. However, because of ecological, economical and technical reasons only one third of this amount can be accounted for. It represents almost 5 million cubic metres of wood a year (Simanov 2002).³

Beranovsky *et al.* (1995) estimate in their book on economic assessment of renewable energy resources that a Czech average family house with heat losses of 15 kJ and a system of central heating, uses 90,000 MJ a year. It is a slightly higher estimate than 72,000 MJ published elsewhere (Gustavsson 1998), including water heating. When an efficient wood burning boiler (such as Verner P25 that is described in the following chapter) is installed with an efficiency of 82 per cent, it is necessary to produce 110,000 MJ a year. This energy can be produced by combustion of 7,675 kg of wood. If the density of fuel wood is 400 kg per a cubic metre, it implies about 19 cubic metres of wood per household using this particular boiler. By implication five million cubic metres of fuel wood would supply 260,000 households in the Czech Republic with the population of 10,500,000 and 4,271,000 households (The Czech Statistical Office, CSO 2003). It means that approximately 6.2 per cent households could be heated with waste wood.

4.5 Estimation of Availability of Wood in The Black Triangle

The Black Triangle

The Black Triangle is an environmentally damaged region that comprises the border areas of three countries: Germany, Poland and the Czech Republic. Its Czech part

³ In Finland, for example, 5.6 million cubic metres of firewood is used annually for space heating (Alakangas 1998).

spreads over 12 districts that belong to three different regions. These regions have the smallest area of forests among all Czech regions. The Black Triangle suffered some of the worst industrial pollution in Europe in the twentieth century (Vanek 1996, Tellegen 1996). This pollution was mainly related to generation of electricity in coal- or lignite-fired power plants. At a household level, the main fuel for heating purposes was also coal and lignite. This led to severe local air pollution especially during the September – May heating period. One of the ways of reducing air pollution and improving the air quality would be to use other sources of energy, particularly renewable energy resources. Since wood seemed a generally abundant renewable resource in the Czech Republic, I attempted to estimate its potential in the area in question.

Two potential sources of fuel wood in the Black Triangle could significantly contribute to production of heat. They are waste wood from local forests and waste products from wood processing industry. It includes waste wood that cannot be used for other purposes because of a very bad quality, is in excess (because of windthrows, for example) and/or has a very low price (Simanov 1993, Jiroudkova *et al.* 1997):

- fire wood, that is wood of too low technological quality for use by other industry (it is usually supplied as 1m long logs and chips;
- logging residues such as tree tops and branches up to 60 mm diameter;
- loppings from cutting the branches and shortening trunks;
- whole trees from cleaning and juvenile thinning in forests including branches and green parts;
- offcuts that originate in the process of manufacturing various kinds of standardised saw wood up to 1m long;

- untreated waste wood (such as offcuts) from wood processing industry;
- saw dust (3-7 mm) ideal for making briquettes;
- tree stumps and roots;
- fuel chips that are disintegrated wood that originate from lopping and thinning, from whole trees, tree tops with branches, thick branches of deciduous trees and offcuts from trunks that are standardised according to its purpose;
- disposed wooden products;

Waste wood that originates in wood manufacturing industry in the Czech Republic

Hanousek (2001) estimates as a percentage of the whole amount:

- 30 per cent comes as offcuts and chips from sawmills;
- 20 per cent comes as dust from sanding machines;
- 18 per cent is bark;
- 10 per cent comes as offcuts of wood from further manufacturing;
- 5 per cent is wooden chips;
- 3 per cent from manufacturing of ply wood and blockboard;
- 2 per cent of veneer;
- 2 per cent originates from machining;

A large amount of waste wood comes from wood attacked by pests, damaged by air pollution and from windthrows.

The districts of the Black Triangle spread over mountainous areas. Forty two per cent of this area is covered by forests. Fuel wood can come from forested areas of the Krusne hory mountains, Doupovske hory mountains, Slavkovsky les forest, Ceske stredohori hills, Luzicke and Jizerske hory mountains.

Dieter Brandt and Michaela Jiroudkova from the Black Triangle project funded by the European Union PHARE programme based in Usti nad Labem, estimated how much fuel wood can be utilised from local forests in a sustainable way. The following table shows the current share of forested land out of the whole area of individual districts of the Black Triangle region (Jiroudkova *et al.* 1997).

TABLE 4.8: Forest Land in Individual Districts of the Black Triangle Region.

District (NUTS IV)	Area (in hectares)	Arable land (in hectares)	Forest land (in hectares)	Other (in hectares)
Ceska Lipa	111,696	45,678	50,766	12,967
Decin	90,919	36,336	44,684	7,379
Chomutov	93,531	39,151	34,109	16,045
Jablonec nad Nisou	40,224	13,043	22,210	3,563
Liberec	92,495	44,461	38,785	6,818
Most	46,713	14,018	15,199	16,269
Teplice	46,915	16,052	17,109	11,935
Usti nad Labem	40,445	18,597	12,479	7,745
Sokolov	75,366	20,529	38,187	14,566
K.Vary	162,802	60,875	67,396	30,016
Semily	69,897	37,595	25,862	4,768
Trutnov	114,653	50,428	53,297	8,274
Total	987,656	396,763	420,083	140,345

Source: Based on data valid on 1.1. 1997 published by the Czech Statistical Office in the conference report The Use of Biomass in Energy Production held on 3 September 1997 in Opocno, the Czech Republic (see Appendix I for explanation of NUTs).

Similarly to Simanov, Brandt and Jiroudkova estimated that only 25 percent of the biomass growth during the life of the forest can be sustainably used as a fuel which

annually represents approximately 0.8 cubic metres of waste solid matter from each hectare of the forest. This represents the potential average amount from a healthy forest.

Waste wood from sawmills and clean uncontaminated recyclable wood used for production of furniture or wooden building material that finished serving their purpose can be added to the counted 0.8 cubic metres of solid matter. Then we get 1.0 cubic metre of solid matter of sustainable income of waste wood of each hectare in stable conditions in the forests when the air pollution situation in the area is improving.⁴

On average 9,000 MJ per cubic metre per solid matter is regarded to be a specific heating value of air dried wood (average of all types of wood) which represents 9,000 MJ per hectare per year. The consumption of energy (including heating of water) per house was in the 1990s estimated as 72,000 MJ. Assuming that the efficiency of new boilers and distribution systems is 80 per cent, we can count that it represents 90,000 MJ of fuel energy per an average household. Thus, 10 hectares of healthy forest vegetation providing 9,000 MJ per hectare would suffice for one household (using waste wood from a sawmill and uncontaminated recycled material). The whole area of the forest in the Black Triangle is 420,083 hectares. It means that approximately 42,000 households could be heated only with waste wood. It represents 7.5 per cent out of 560,000 households in the Black Triangle region.

⁴ Jiroudkova *et al.* (1997) point out that when projects are being considered it is important to take into account that the dead trees in top mountainous parts of Krusne hory, Jizerske hory and Krkonose have been almost completely felled as a consequence of long-term pollution (acidification). Newly planted trees do not yet provide sufficient amount of waste wood for large central heating projects but only for small projects.

Burning wood is generally perceived as a marginal method of supplying households with heat. It is regarded as a suitable way of heating for remote settlements based near the source of fuel. In the case of the Czech Republic, there are also other factors that support this general conclusion. About 80 per cent of households are supplied with heat from district heating schemes, or from systems that serve one or more flats in a building (CSO 1998). According to the microcensus carried out by the CSO in 1996 in 6,000 households, 98.5 per cent of surveyed households with district heating were in towns and only 1.5 per cent in villages.

Wood is preferably used by village dwellers which in the Czech conditions means in settlements of up to 2,000 inhabitants. According to the CSO survey (1991) there were 51,402 (one-family) houses in districts of Decin, Chomutov, Most, Teplice and Usti nad Labem⁵ out of which 15,827 houses were in settlements of up to 2,000 inhabitants. According to the Litomerice District Statistical Office survey (1998), 5,143 (one-family) houses in villages up to 2,000 inhabitants were supplied with gas. It is very likely that recent introduction of gas and investment in gas boilers prevented people from considering other fuels, although the price of gas was relatively high and has been continuously rising since the mid-1990s according to the Czech Energy Regulation Office⁶ (Adamkova 2003).

The remaining 10,684 houses were households which were not supplied with gas. This figure can be related to the above mentioned estimate by Brandt and Jiroudkova (1997) in which they calculated that approximately 10 hectares of forest land should

⁵ These are only five districts (NUTS IV) out of twelve districts of the Black Triangle, the only districts for which all the data were possible to gather.

⁶ Energy Regulation Office – Energeticky regulacni urad (ERU).

provide fuel for one household. The area of forested land in the districts of Decin, Chomutov, Most, Teplice and Usti nad Labem was 123,580 hectares in 1997 (see Table 4.8). It means that 12,000 households could be heated with sustainably obtained waste wood and there would be even a surplus of sustainably obtained waste wood which could cover demand for domestic fuel in village households that are not connected to a gas supply.

4.6 Conclusion

Centuries long tradition of forest husbandry contributed to the relatively stable current situation in the Czech forests. Problems such as salvage felling, unsuitable mixture of species grown at unsuitable altitudes and growing unauthorised felling have an adverse effect on the stability of the production of wood. However, they do not seem to represent a significant threat to the overall production of wood. The issues of salvage felling and unsuitable mixture of species are being addressed by the new forestry policy. According to the Ministry of Agriculture statistical evidence is now available that indicates that the ministry's long-term policy focusing on planting a more suitable mixture of species has contributed to steadily decreasing salvage felling. Unauthorised felling represent a serious problem that has not been very successfully tackled so far. Although the published figures (Table 4.7) suggest less than one per cent of the annual authorised felling, the worrying fact is that it is not known what the undiscovered and therefore unrecorded unauthorised felling might be. The Ministry for Agriculture did not publish any such estimates in their last available report describing the situation in 2001.

According to the available estimates there should be enough sustainably obtained waste wood for energy purposes both at the level of the whole country and in the Black Triangle region. The estimated amount of sustainably obtained fuel wood could potentially satisfy the needs of 260,000 households in the Czech Republic. As regards the Black Triangle, the estimates show that 7.5 per cent of households could use wood to generate heat. The fact that wood is a suitable fuel mainly for village dwellers who do not have access to other 'clean' sources of energy makes the group of potential wood users smaller. The estimate considers village households that were connected neither to district heating nor to a gas pipe. It shows that a surplus of waste wood existed in five selected districts within one region of the Black Triangle, if all these households decided to use wood for heating.

CHAPTER 5: TECHNOLOGY

5.1 Introduction

To achieve efficient generation of energy from wood in a way that is not harmful to the environment is not a simple task. Old wood or coal-fired stoves or boilers made of sheet metal often used for burning wood cannot be regarded as such technology. This chapter investigates the availability of modern wood-fired systems in the Czech Republic and examines the 'environmental friendliness' of the most popular Czech product used in households. This chapter proceeds as follows: First, in part 5.2 the theoretical background of the process in which wood is efficiently burnt is described. It is followed in sections 5.3 and 5.4 with a review of the Czech market technology. Part 5.5 looks more closely at the environmental consequences relating to combustion of wood using the technology described in this chapter.

5.2 Efficient Combustion of Wood

When exposed to an increasing temperature, biomass evaporates water. Then the gaseous part of the fuel is released. When the ignition temperature is reached and there is sufficient supply of air the gas ignites and consequently energy in a form of heat is released. This heat can reduce further the amount of water in the rest of the wood and releases more flammable gas. Carbon stays on a grid in a stove and its surface is oxidised to carbon monoxide. When more air is supplied carbon monoxide is oxidised to carbon dioxide. When insufficient air is present the biomass burns in an incomplete combustion. The incomplete combustion which takes place in traditional wood burning stoves or fireplaces used for domestic purposes is often due to lack of control over the combustion process leading to pollution in flue gases. The colour of

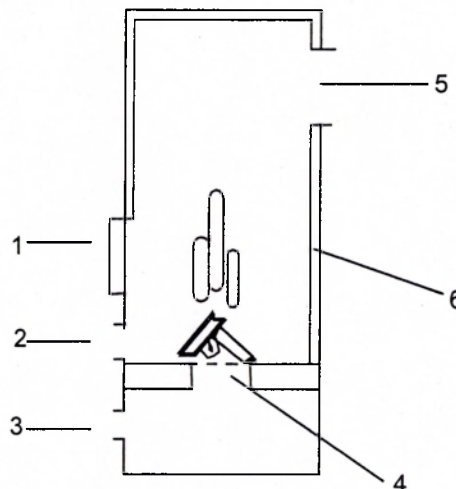
the smoke indicates the efficiency of the burning process. The more black the smoke appears the less complete is the burning process. White colour of the smoke indicates a high content of water. Water content in wood up to 30 per cent can cause problems of pollution. Emissions of pollutants such as soot, carbon monoxide and unburnt hydrocarbons present in the smoke are likely to be detrimental to the local air quality. Pollutants include volatile organic compounds (VOCs) and carcinogenic polyaromatic hydrocarbons (PAHs). Some of the substances such as tar present in the combustion process can only be burnt at temperatures higher than are normally reached in conventional stoves and fireplaces. High levels of hydrocarbons are normally coincident with high levels of carbon monoxide, which is a symptom of inefficiency in the combustion process since combustion to reach CO releases only 30 per cent of the heat that is associated with the formation of CO₂ through complete combustion (Cowburn 1998).

Among the solid fuels, wood has the highest share of gaseous compounds (75-85 per cent) released by pyrolysis. These compounds do not burn on the grid of the appliance but between the grid and the chimney. It is the cause of the long flame characteristic of burning wood. This particular feature determines the design of an appliance combusting wood described by Simanov (1993) in Figure 5.1.

- only a smaller part of the air needed to oxidise fuel should be drawn under the grid; this so called primary air usually represents 40 per cent of the whole volume of air needed;
- a larger proportion of the air is led into the chamber behind the grid where the released gases are drawn; this so-called secondary air usually represents 60 per cent of the whole volume of air required;

- chamber above (or behind) the grid cannot be constructed for maximum heat exchange as its purpose is to keep gases and oxygen coming at or above the required ignition temperature, and so it needs a fireclay lining; to avoid delayed burning of flue gases in the chimney (whose consequence are losses of efficiency and ecologically undesirable content of smoke gases), the time during which burning gases stay in this space has to be at least 0.5-0.8 seconds;

Figure 5.1: Appliance Combusting Wood [based on a description by Simanov (1993)]

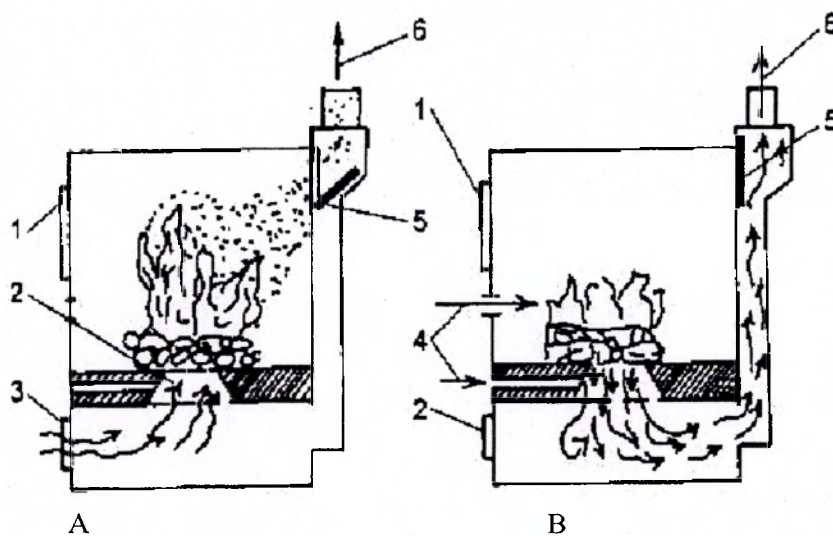


- 1 a door through which wood is loaded
- 2 incoming air (60 per cent)
- 3 incoming air (40 percent)
- 4 a grid
- 5 a chimney
- 6 a fireclay lining

It is possible to burn wood in appliances designed for other solid fuels such as coal but with a low efficiency and high pollution release into the air. It is vital that the

negative environmental impacts of the wood combustion process are minimised especially as far as small domestic appliances are concerned. Such installations are difficult to control by their users. New technologies appeared on the Czech market in the 1990s. They were newly designed combustors. In these systems the particle laden flue gases that in conventional stoves would be released into the atmosphere are drawn instead into a second chamber where they are combusted as other fuel gases. These combustors are based on pyrolysis and are designed for a dry wooden fuel (ideally with 20 per cent of moisture), such as logs, waste wood from logging, cuttings and sawdust. These boilers can be adjusted for burning wooden briquettes and pellets (Hanousek 2001):

Figure 5.2: Burning in Boilers Based on Pyrolysis (adapted from Hanousek 2001).



- 1 a door through which wood is loaded
- 2 a venturi
- 3 a door through which ash is removed
- 4 incoming air
- 5 chimney flap
- 6 chimney

When a fuel is loaded, the door (1) is closed and the ashtray door (3) is opened (picture A). Air flows to the fuel through a grid as is common in other boilers. Flue gases are drawn directly through the open flap (5) into the chimney (6). The process of pyrolysis starts when the boiler is glowing (usually when the boiler is loaded for the second time) and a layer of hot ash develops on the grid (picture B). The ash-tray door (3) and the chimney flap (5) are closed and the direction of the flue gases is reversed. The boiler is equipped with the venturi (2) through which the secondary air flows into the uncombusted gases. In passing through the glowing layer of the fuel, the gases warm up to the ignition temperature. Enriched by CO they start to burn in the venturi and finish burning under the venturi (Hanousek 2001).

Pesat *et al.* (1998) identified four major types of units burning wood fuel in the Czech Republic:

- one very large wood burning thermal plant in the Paskov cellulose enterprise with an output higher than 10 MW;
- about 100 large size units with a heat output from 1 to 10 MW that operate in wood processing industry;
- about 100 medium size boilers with a heat output from 100 up to 1000 kW;
- small local boilers with an output from 5 up to 100 kW which burn mainly wood logs, but also wood chips and wood or straw briquettes; there were more than 30 thousand in operation in 1998;

In order to find out whether there is a modern efficient technology available in the Czech Republic Czech market was researched twice, first in 1996 and again in 2002. The question of the availability of boilers designed for efficient combustion of wood

in the Czech Republic was examined with SEVEN (Energy Efficiency Centre in Prague) and EcoWATT (Centre for Renewable Energy Resources in Prague). Information concerning the use of renewable energy resources was obtained from the EcoWATT's database on technology combusting wood.¹

5.3 First Examination

In 1996, information was provided from 5 companies producing boilers especially designed for wood. Other characteristics considered as important for consumers were the price, the period between refuelling, efficiency, frequency of ash disposal, fuel consumption and environmental characteristics which were explicitly presented only in the case of boilers made by Verner and approved by the state test laboratory. Some of the products held an eco-label Environmentally friendly product.² According to the Directive of Ministry of Environment No. 13-2002 issued seven years after the first examination of the market, Biomass-Fuel Hot-Water Boilers belong to the product Category No. 13. This product category is concerned with heating sources for households, furnaces and low-output local heating units. The laying down of requirements for awarding the eco-label and pollutant concentration limits is intended to contribute to more intense development of modern combustion facilities. Product are supposed to fulfil the following criteria:

- thermal output should be regulated in a range of 50-100%;

¹EcoWatt (prepared for publishing in 1999): Database.

²The National Programme for Labelling Environmentally Friendly Products, the Czech Ecolabelling system. The system belongs to the EU harmonisation requirements that have to be met by the Czech Republic for joining the European Union. It is a selective and voluntary arrangement. In accordance with the decision of the Minister of the environment, the Environmentally Friendly Products label can only be awarded to products provably meeting all functional and ecological criteria. These criteria are set out in the directive of the Ministry of the Environment for a selected and precisely defined product category [online]. Available from <http://www.ceu.cz/esv/>. [Accessed 22 March 2003].

- the refuelling period should be minimally 12 hrs for wood;
- emissions and thermal efficiency should fulfil given criteria;

TABLE 5.1: Results of the Search for Environmentally Friendly Wood Burning Appliances in 1996.

Manu facturer (see Appendix II for more details)	Verner	Dakon	Horal	Ferka (stove)	Atmos
Output (kW)	25 - 75	13-28	16-100	-	10-80
Price (thousand Czech crowns)	30-40 (938- 1250 Euro)	8-12 (250-375 Euro)	18-92 (500-2875 Euro)	5-14 (156-1438 Euro)	17-50 (531-1563 Euro)
Period between refills (hrs)	8-12	6-20	4-10	up to 8	-
Fuel consump-tion kg/hr or m ³ per season	15-45	10-15	4-25 6		4-18 10-50
Recom- mended fuel (humid.%) with f.value (GJ/t)	fuel wood wood. briquette s 15-20	fuel wood max.20-25	fuel wood wood. residues 15	fuel wood w. residues	fuel wood w. residues 15-18
Efficiency (%)	83	80-90	85-90		80-88

Note: '-' indicates that the data is not available.

According to producers, products are available in a wide range of output, design and prices, from air boilers to simple but efficient stoves. The fuel recommended in all boilers is very dry wood that may require a long process lasting from 1 to 2.5 years depending on the size of logs up to one m long. The content of water in wood affects the efficiency of the burning process (TABLE 5.2). Fresh wood is unsuitable.

TABLE 5.2: Heating Value of Wooden Chips in Relation to its Water Content.

Water content	Fuel	
	Wood	Bark
percentage	MJ/kg	MJ/kg
0	18.5	18.8
10	16.4	16.7
20	14.3	14.6
30	12.2	12.5
40	10.1	10.5
50	8.0	8.4
60	6.0	6.3

Source: Hutka *et al.* 2000

5.4 Second Examination

Second examination of the market in 2002 showed a substantial increase in range of technology on offer including open fire inserts, equipment with high outputs and also appliances designed to burn wood with electricity generation. Similarly, the availability of information on technology has remarkably expanded. Unlike in 1996 when the information was difficult to obtain and potential buyers of boilers burning wood did not have any sources of advice except for the NGO EkoWATT, the situation was very different in 2002. Much information was obtainable on the Internet. Databases with producers of boilers were found. With the databases there were also services found that provided the option to ask questions to the producers about the appliances they were producing. There were also services provided to advise people who want to purchase a boiler. There was advice given on what should

they decide prior to the purchase of the appliance, how much fuel they would need, if they were entitled to some financial support and how the economics of the switch to a new fuel should be thought through. This service was provided on the web site of a non-governmental non-profit organisation EcoWATT³ and a an information server TSB info⁴ focused on technical equipment of buildings.

Using the information from the two servers I found eight Czech companies that produce boilers with output up to 100 kW. The figure includes four companies that provided information in 1996. Several dealers that import foreign appliances were also found. Producers of boilers with an output higher than 100 kW were not found in 1996. In 2002, however, I found seven Czech producers of boilers that advertise products with output up to 10 MW. They supply the complete package of equipment for a boiler room. It is a clear sign of a growing interest in using wood for heating on a larger scale. Additionally, there are several producers and importers of stoves and open fire inserts. Co-generation is also more in demand. I found three Czech firms producing co-generation units. Balco presents itself as a company of an association that produces assembles and services biomass fuelled co-generation units with a range of output from 10kW electricity and 15 kW of heat to 80 kW of electricity and 120 kW of heat. I also found two companies (ATEKO and Skoda Plzen) producing appliances with co-generation with an output higher than 100 kW.

³ Available from <http://ekowatt.cz>. [Accessed on 22 March 2002].

⁴ Available from <http://www.tzb-info.cz> [Accessed on 22 March 2002].

5.5 Environmental Aspects of Burning Wood

There is evidence (Simanov 1993) that wood as a source of energy does not pollute the air to the extent as fossil fuels because emissions from burning uncontaminated wood do not contain sulphur, halogens or heavy metals. However, this relative harmlessness only applies to complete combustion. When combustion is not complete, flue gases contain more carcinogens than other fuels.

Water content in wood up to 30 per cent does not cause problems of pollution. However, higher content of water may increase occurrence of pollutants, so that it exceeds the limits set by the Czech legislation.⁵ Producers of technology should guarantee that their design of appliance when fed with fuel of the water content they recommend, would fulfil the conditions set by the law. The person who is maintaining a particular appliance and chooses fuel is responsible for its quality in relation to its water content. However, it depends on how the person is informed and responsible since reaching the optimal dryness of wood can be a slow process. Water content in wood varies between 60 per cent for fresh wood to 20 per cent for a very dry wood. Water content of 20 per cent can be reached by letting the wood dry for two years on average that applies for domestic sized lumps of wood (up to one m long). To encourage drying, the wood should be cut to stove length. Then splitting exposes more surface area to the air and lumps of wood will dry faster. Firewood should be stored criss-crossed in piles to allow air to circulate within the stack. The ideal stacking site should have low humidity, good air circulation, and full sunlight. Wood should not be stored directly up against a building (Oregon State University

⁵ Act 309/1991 from 9 July 1991 about the protection of air against pollutants (Air Act).

2003). Since there is no law prosecuting individuals who cause pollution by their own chimney in the Czech Republic, it depends entirely on awareness, the good will of consumers and their ability to stock wood in advance whether they use dry fuel or not.

Carbon absorbed in vegetation circulates between the atmosphere and vegetation by photosynthetic and respiratory processes. New growth of biomass requires carbon as a raw material. During the combustion process carbon is oxidised to CO₂, releasing thermal energy. The CO₂ released in the combustion of biomass is assumed to balance the CO₂ removed from the atmosphere during the sustainable production of biomass. It is assumed that the net CO₂ emission from burning logging residues is zero as long as the forests are allowed to re-grow after logging.

Possible excess presence of persistent organic compounds (POPs) in the flue gases, such as carcinogenic polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) which is a group of toxic pollutants that can become concentrated in animal tissue, polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in particular, may represent a serious threat to wood's reputation as an environmentally sound fuel. PCDDs comprise about 70 chemical compounds and PCDFs about 130 chemical compounds; they are generally known as dioxins. Dioxins are among the most poisonous chemicals known, they are life threatening in very small concentrations. The tolerable daily intake (TDI) of dioxins to which a human can be exposed without harm is 1 to 4 picogrammes per kilogram body weight. They cause cancer and affect foetus (World Health Organisation 1999).

Launhardt (1998) analysed pollution caused by combustion of untreated wood (Launhardt 1998). He compared several appliances designed and used for combustion of wood in Germany. It was found out that PCDD/Fs were formed in detectable quantities by combustion of natural untreated wood in domestic furnaces. However, he reported very low concentrations of pollutants both in flue gases and ashes or soot. In most cases he found that the PCDD/F contamination of the total combustion residues was even lower than in the fuel except for PAHs that build up by combustion particularly when older technology is used. However, he did not find the alarming pollutant concentrations that were measured in the early 1980s. Launhardt (1998) suspected that these must have been caused by improper or illegal fuel.

Chemical analysis of the smoke has been carried out on the most popular Verner 25 boiler (Koutsky *et al.* 2002). Preliminary measurements suggested that concentrations of PCDDs and PCDFs exceeded the limit set for waste incineration plants where release of these compounds is possible and under a strict control (Koutsky *et al.* 2002). In this experiment described by Koutsky the concentration of PCDDs and PCDFs for Verner 25 were 7.1 TEQ (ng per cubic metre), while the limit for waste incineration plants is 0.1 TEQ (ng per cubic metre). However, Koutsky believes that the temperature during the experiment (260 – 400°C) and the nature of sawdust briquettes (small particles that easily disintegrated) used as a fuel in this experiment contributed to pollution⁶. Koutsky *et al.* (2002) concludes that a significant reduction

⁶ The series of reactions resulting in PCDD and PCDF are based on a theory of a 'synthesis de-novo' which means that the reactions take place on carbon particles in flue gases, temperature 200-400°C (Koutsky *et al.* 2002)

of pollution will possibly be achieved by adjusting the combustion conditions and design of the appliance.

Other aspects of the use of fuel as an energy source that have to be taken into consideration are the environmental impact of the use of the fuel required for logging. The fuel used for transport of wood from a forest to the consumer has to be also accounted for as well as the energy used for producing briquettes.

5.6 Conclusion

More than 30 thousand efficient boilers were sold in the Czech Republic before 2002. The same amount was also exported. This figure is evidence that there is an increasing interest in efficient burning of wood. Its growing popularity is apparent from the increasing choice of products that are available for the household purposes as well as equipment with higher output designed heating of more than one household. On the top of that Sladky (2003) estimates that there might be hundreds of thousands of wood burning appliances of various designs used in holiday homes. The dissemination of information for potential users about the available technology in 2002 was on a much higher level than it was in 1996 when the market was researched for the first time.

The technology described in this chapter is presented as an efficient and environmentally friendly technology. However, these two characteristics cannot be taken for granted. Efficiency as well as environmental friendliness of this technology is affected by the design of the appliance and to a great extent by the quality of the fuel that is used. The design of the appliance is up to its producer and its

environmental harmlessness is guaranteed by a successful enforcement of relating laws. However, even if the best available technology is used the quality of fuel is dependent entirely on the awareness of consumers.

CHAPTER 6: FACTORS INFLUENCING DECISIONS TO USE WOOD AS A DOMESTIC FUEL: 1996 PILOT SURVEY

6.1 Introduction

To establish why and how people decided to use wood for heating their houses using 'environmentally sound' appliances required gathering data on actual wood users at the individual level. To that end I constructed a pilot questionnaire on the basis of which I conducted a number of interviews with people who used wood as a source of heating in their households. The original intention was to develop a more formal survey on the basis of the pilot survey. This chapter proceeds as follows: First, the theoretical considerations underlying this part of my research are presented in connection with the situation in the Czech Republic in the mid-1990s in part 6.2. It is followed in section 6.3 by the description of the survey which I conducted in the Czech Republic to test the applicability of the theory of reasoned action to the case of the switch to wood as a domestic fuel. The answers are analysed in part 6.4, 6.5 and 6.7. The concluding part 6.8 of the chapter explains how the outcomes of the questionnaire informed the next direction of my research.

6.2 Theory of Reasoned Action and the Czech Context

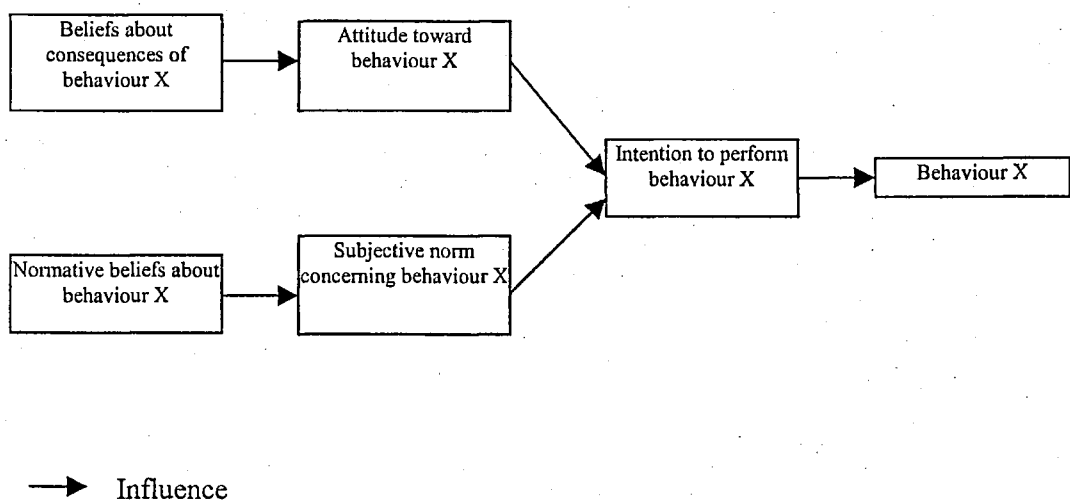
As described earlier in chapter 5 of this thesis, by mid-1990s a market in modern technology designed for combustion of wood had developed in the Czech Republic, which meant that there were consumers who generated demand for this technology. Domestic users who decided to use modern, sophisticated and expensive appliances had to have a strong reason to switch from other fuels to wood. Wood as a domestic

fuel, although widespread and common in the past (Folk 1935), was not usually used on an every day basis in the early 1990s. The most common fuel used for domestic purposes in households that were not connected to central heating supply was lignite. It was a cheap fuel with a developed supply system. However, the use of lignite for both producing electricity and heating houses caused, along with other industrial pollution, severe environmental damage in the Czech Republic, particularly in the north-western part of Bohemia. The ecological devastation of this region was unprecedented in Europe (Vanek 1996, Tellegen 1996). People in this area were well aware of human health and environmental consequences of air pollution caused by high content of sulphur in smoke coming out of industrial smokestacks and residential houses' chimneys (Vanek 1996). Historically, environmental awareness of the Czech population reached its peak in the period 1989 – 1990 and was an important factor of political mobilisation that brought down the communist regime in November 1989 (Jehlicka *et al.* 1994). Thus one reason why people decided to switch to wood might have been their experience of environmental deterioration arising from the use of fossil fuels and the desire to improve their local environment.

An individual making decisions about environmental issues can do it while adopting several different roles. These include an individual concerned with the environmental issue(s) at hand, an individual as a consumer and an individual as a citizen (Blackmore 1997). People have different values in relation to each of these roles. As a citizen, for instance, an individual is concerned with the good of the community rather than with self-interest, which is expressed in the individual's role as a consumer (Sagoff 1989). The factors influencing behaviour can be modelled through a theory of reasoned action (Fishbein 1975). According to this theory, the immediate

antecedent of any behaviour is the intention to perform the behaviour in question (Fishbein 1985). The theory specifies two independent determinants of intention - attitude towards behaviour and subjective norm (a social factor). At the most basic explanatory level the theory postulates that behaviour is a function of salient information or beliefs relevant to the behaviour. Two kinds of beliefs are distinguished behavioural beliefs and normative beliefs. Behavioural beliefs represent the information an individual has about the object in question while attitude refers to the person's feelings and favourable or unfavourable evaluation of the object. Behavioural beliefs are assumed to influence attitudes towards the behaviour. Each behavioural belief links the behaviour to a certain outcome, or to some other attribute such as the cost incurred by performing the behaviour. Normative beliefs, on the other hand, are concerned with the likelihood that important referent individuals or groups would approve or disapprove of performing the behaviour. Normative beliefs constitute the underlying determinants of subjective norms. In Figure 6.1 Fishbein illustrates the factors influencing intentions and behaviour:

FIGURE 6.1: Factors Influencing Intentions and Behaviour - Adapted from Fishbein (1975)



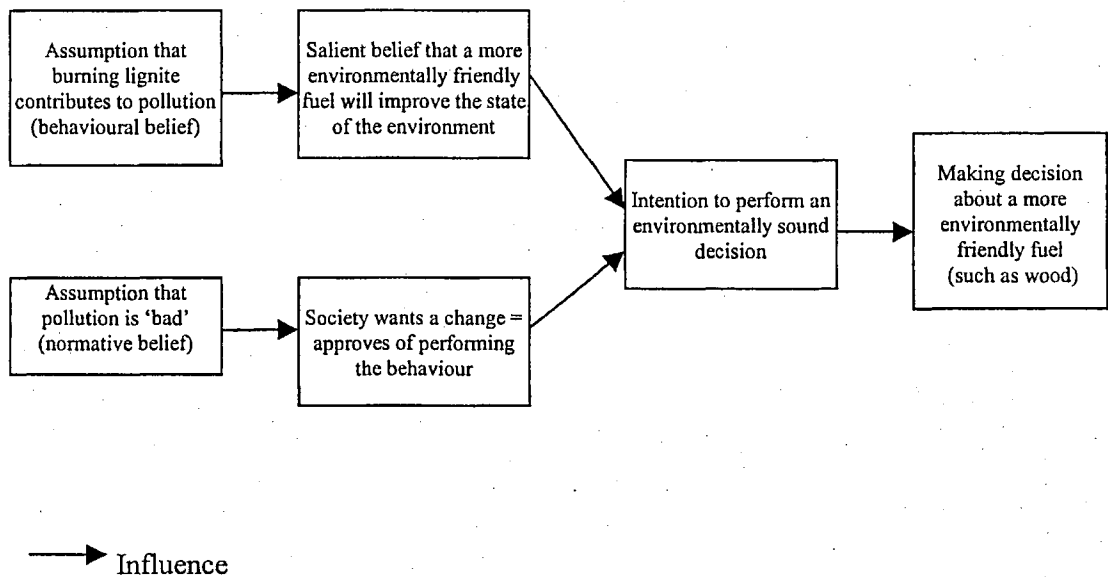
If people were aware of the fact that air pollution was 'bad' that could be an example of a normative belief. Then the assumption that burning lignite contributes to it could represent a behavioural belief.

According to Fishbein a person's attitude towards an object is based on his/her salient beliefs about that object. The following paragraph describes a widespread conviction among the Czech people that environmental pollution was a severe problem that required an effective response. In a 1990 survey citizens were asked a question 'What do you regard as the most important problem that should be tackled by the government?' Eighty three per cent of the respondents saw the environment as the most pressing problem the government should engage with (Moldan *et al.* in Vanek 1996). People did not regard the rest of the problems, such as a limited choice of consumers' goods on the market, housing problems or shortage of medicine as being as important as environmental pollution. Such a strong normative belief that action should be taken, shared by large sections of the society and the government, could create conditions in which a person's attitude towards the performed behaviour was based on the salient belief to perform a more environmentally friendly behaviour.

Experience of the annually repeating high concentrations of ground level air pollution associated with inversions led to a series of environmental demonstrations in the North-Bohemian Region in 1989 (Vanek 1996) that challenged the communist authorities. This high level of environmental concern and environmentally related solidarity could represent a subjective norm so that the other citizens would approve of an environmentally friendly behaviour. It could have subsequently led to a decision made at the individual level to switch to an environmentally friendly fuel

such as wood. Fishbein's model then could be used to explain whether environmental awareness played a role when individuals decided to use wood as a domestic fuel.

FIGURE 6.2: Environmental Awareness Playing its Role in Making Decision About a Switch to an Environmentally Friendly Fuel: Adaptation of the Fishbein's Model.

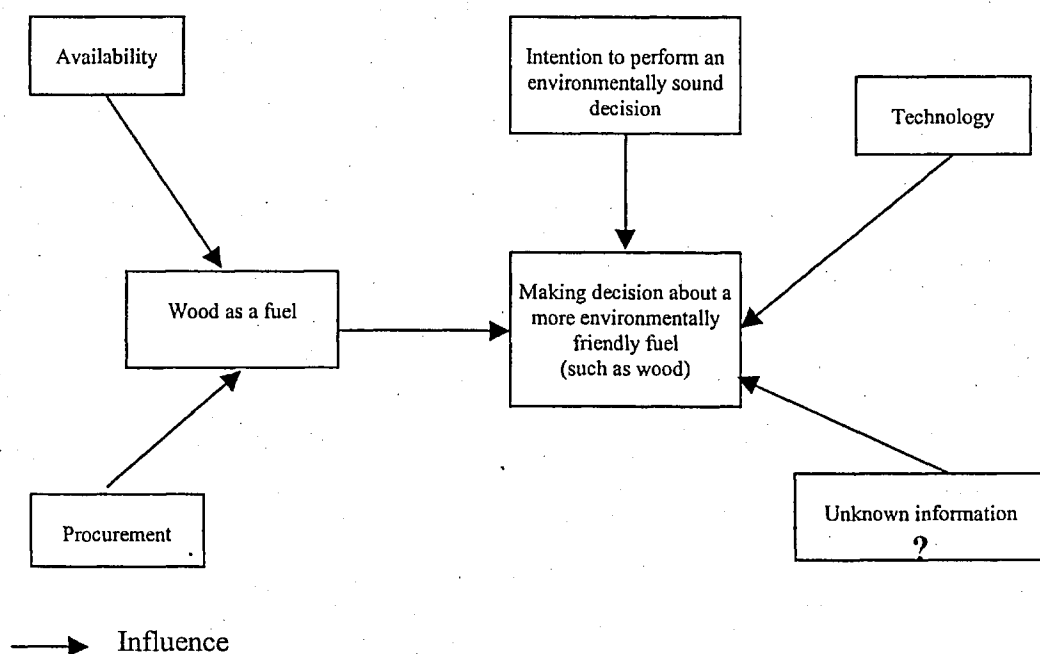


Fishbein's theory only applies to behaviour performed under volitional control (one's control influenced by one's will). He argues that the more that performance of a behaviour is contingent on the presence of appropriate opportunities or on possession of adequate resources (e.g. time, money, skills, co-operation of other people), the less the behaviour is under volitional control.

Severe environmental conditions might have had an impact on behaviour of people who decided to switch from coal to more environmentally friendly fuels. However, there were also other factors that played a role and influenced the switch from lignite

to wood as a domestic fuel and derogated volitional control of the decision-making process. At the practical level, the factors that need to be considered during the process in which people make decision about switching to wood are availability of environmentally friendly technology, availability of wood and customer friendly and affordable procurement of the fuel. Further factors were expected to be disclosed in the survey (Unknown information in FIGURE 6.3).

FIGURE 6.3: Factors Influencing Decision Making on the Use of Wood as a Household Fuel



In order to test the applicability of the theory of reasoned action to the case of the switch to wood as a domestic fuel a pilot survey was conducted. This survey was designed and pilot survey carried out among wood users who decided to heat their houses with wood and chose for this purpose an efficient and environmentally friendly technology. These individuals lived in the area of north-western Bohemia often referred to as The Black Triangle due to high levels of environmental pollution.

It was anticipated that they had both the experience of the environmental damage in this region as well as of environmentally related solidarity that was present in this area in the late 1980s.

6.3 Description of the Pilot Survey

The aim of the survey was to find out what reasons respondents had for switching to wood as a domestic fuel and whether they found it convenient and economical.

Preparation

My original intention was to design three types of questionnaires:

1. Questionnaire for consumers who use wood as a domestic fuel and burn it in purpose-designed boilers or stoves.
2. Questionnaire for people who live in similar conditions (area) and use other domestic fuels than fuel wood.
3. Questionnaire for owners and attendants of wood burning appliances used for other than domestic purposes (such as hotels and small factories.)

The intention to conduct these three types of a questionnaire was based on an anticipation that there might be a significant difference between environmental

awareness of individual wood users and users of other fuels. Since another objective of the survey was to find out whether the interviewees found the fuel wood they were using convenient and economical it was anticipated as essential to compare this gained knowledge with the experiences of users of other fuels. In order to get a more complete picture about the wood burners, a questionnaire was prepared for owners and attendants of wood burning appliances used for other than domestic purposes.

A series of informal personal interviews were conducted. Each question was read aloud to the interviewee. The answer was then recorded in the questionnaire form. Ensuing discussions were encouraged in order to gain a greater depth of knowledge in every question of the questionnaire, except for Part 4 which the interviewees filled themselves. Notes from the discussions were recorded also in the questionnaires. Most of the interviews took place in the interviewees' homes.

All questionnaires consisted of four parts. In order to identify possible factors that might have played a role when making the decision to switch to environmentally friendly wood burning technology, detailed questions were asked about the appliance in Part 1. In this part consumers were asked where they learnt of the appliance, about its cost, what fuels they used before, their experiences of maintaining the appliance and whether they were satisfied with it. Since fuel, its cost, procurement and preparation were anticipated as the important factors influencing individuals to make a switch from other fuels, wood fuel was covered in Part 2 of the questionnaires. In Part 3 of the questionnaires the interviewees were asked whether they had concerns about the environment in which they were living. They were also asked if it was their salient belief that wood as an environmentally friendly fuel would improve the state

of the environment. In Part 4 more questions were asked about the interviewees' personal situation and awareness of the environmental issues.

6.4 Questionnaire for Consumers who use Wood as a Domestic Fuel and Burn it in for this Purpose-designed Boilers or Stoves.

Part 1

In this part of the questionnaire I asked about the appliance respondents used for heating in their house.

1. What type and size of the appliance do you have?

The purpose of the question was to elicit whether the respondents were really using an environmentally friendly appliance.

2. How did you learn of the boiler (stove)?

This question aimed at disclosing the source of information they used when they were making decision to buy their appliance and whether there was a link to an environmental organisation disseminating the information on such appliances.

3. When did you buy it?

This question's purpose was to reveal how long they had been using the appliance and consequently the degree of their familiarity with the appliance's operation.

4. How much did you pay for it?

Question 4 aimed to disclose how much was paid. Ensuing discussion aimed to disclose whether the respondents paid the whole cost of the appliance or whether they received a financial aid (which could have an impact on making their decision).

5 Did you have a similar appliance before?

Question 5 aimed to reveal whether the respondents really made a switch from a non-renewable to a renewable energy resource.

The purpose of questions 6 to 9 was to elicit what experience the respondents gained after adopting the new technology:

6. How much time do you spend on managing the boiler (stove) every day during the heating season?

(adding fuel, cleaning appliance, removing ash, maintenance and repairs)

7. How much time do you spend on managing the boiler (stove) every day during the rest of the year?

(adding fuel, cleaning appliance, removing ash, maintenance and repairs)

8. Can you compare the time you spend now on managing your boiler (stove) with the time spent on managing your previous appliance?

9. Are you satisfied with your boiler (stove)?

If yes why?

If not why?

Part 2

In this part I asked questions relating to the fuel that interviewees used in their boiler (stove).

1. What fuel do you use in you boiler (stove)?

Fuel wood (FW)

Wooden briquettes (WB)

Other

The purpose of question 1 was to identify more precisely the fuel that respondents used because environmental consequences of the use of wooden based fuels vary, as does the comfort of their use and their impact on the appliance.

2 Do you buy fuel?

3. *If yes, do you buy fuel from a single source or from several suppliers?*

Wooden briquettes are goods which are sold in standardised packs in a conventional way in shops as opposed to fuel wood, that is sold in various bulk sizes and usually in saw mills or in forests by forest companies.

4. *Do you think that the price you pay for fuel represents a good value?*

5. *What is the maximum you would be willing to pay for your present fuel (a year)?*

A 6,000Kc(186 Euro) B 9,000Kc(281 Euro) C 15,000Kc(469 Euro) D
20,000Kc(625 Euro)

The purpose of question 4 and 5 was to reveal whether the respondents found wood as an economical fuel which could have an important impact on their decision.

6. *Do you physically engage in obtaining and preparing of fuel?*

If yes how do you organise this activity and how long does it take? (does somebody help you, how long does it take, how often)

7. *Are you satisfied with procurement of wood?*

(is there a sufficient supply of wood, is it easily procurable, would you prefer to obtain it in a different way [for example in a less labour intensive way])

Procurement of fuels varies and influences the comfort of use of the appliance. The goal was to find out whether involvement of heavy labour affects the respondents' feelings about the decision they made.

8. *Do you regard wood as a convenient fuel?*

If yes why?

If not why?

9. *Do you think that heating with fuel wood should be supported from 'above' (by the government or local councils)? If yes, how (subsidies, advertising, better organisation of supply, support of central biomass heating projects).*

The purpose of this question was to identify whether the consumers want to be helped by authorities and what they want to be helped with.

Part 3

In this part of the questionnaire I asked what the interviewees' feelings were about the environment in which they were living.

1. How long have you been living in Northern Bohemia?

The purpose of this question was to find out if the respondents might have strong connections to the region.

2. In your opinion, what are the major problems in the region and how should they be eradicated?

The goal was to find out the respondents' relative concern with the environment as opposed to other problems of life in the area.

3. In your opinion, what represents the major environmental problems facing society in the region and how should they be eradicated?

The question tried to elicit what the respondents think about solving environmental problems and whether they linked their solutions with a change in their own behaviour.

4. What do you usually do in your spare time?

The purpose was to find out whether the respondents' hobbies relate to environmental concerns or organisations.

5. Do you think that heating with wood has a future in the area in which you are living?

If yes, why?

If no, why?

The goal was to find out if the respondents believe that wood can be a long term feasible alternative for other fuels in their neighbourhood.

6. Do you think that heating with wood has a future in your region?

If yes, why?

If no, why?

The goal was to find out if the respondents believe that wood can be a long term feasible alternative for other fuels in the region.

7. What are in your opinion major obstructions to development of heating with wood in North Bohemia?

Part 4

Finally I asked some further questions about interviewees and their personal situation

1. In which year were you born? I was born in 19...

2. What formal qualifications you have gained? (please tick)

basic school

apprenticeship

(c) A-levels: gymnasium

technical high school

other

(d) Higher education (please specify): university

polytechnic

Post-graduate

Other (please specify)

3. Do you own the house (flat) in which you are living?

4. *How many rooms are in the house (flat) in which you are living?*

5. *How many people live in your household?*

Number of adults

Number of children

6. *Which of these statements best describes what you (and your partner) were doing last week (that is seven days ending last Sunday)? If you were on holiday, what was your major occupation before you went away? (please tick)*

You Your partner

(a) In paid full-time work (42.5 hours a week or more)

(b) In full-time education

(c) In paid part-time work (less than
42.5 hours a week)

(d) Unemployed

(e) On maternity leave

Permanently sick or disabled

(g) Retired

(h) Looking after the home

(i) Other (please specify)

7. *What best describes your and your partner's work? If you are not working now, please think about the most recent job you held. (please tick)*

You Your partner

(a) Farmer or farm manager

(b) Farm worker

(c) Skilled manual work

(e.g. plumber, electrician, cook,

hairdresser)

- (d) Semiskilled or unskilled manual
work (e.g. cleaner)
- (e) Professional or technical work
(e.g. doctor, school teacher, engineer,
social worker, accountant, computer
programmer)
- (f) Manager (e.g. company director,
manager, local authority officer)
- (g) Clerical (e.g. clerk, secretary,
telephone operator)
- (h) Sales (e.g. shop assistant, commercial
traveller)
- (i) Other (please specify below)
- (j) Never had a job

8. *Are you employed locally?*

If yes how long does it take you to get from your home to work?

9. *Do you commute to another area to work?*

If yes how long does it take you to get from your home to work?

10. *The average month's salary in the Czech Republic is approximately 8,000Kc (before tax). Compare it with your (and your partner's) monthly income. Is the amount of money you (and your partner) earn sufficient for the needs of your household?*

You Your partner

- a) much lower

- b) lower and insufficient
- c) lower but sufficient
- d) average (approx. 8,000Kc)
- e) more and sufficient
- f) more and insufficient
- g) much higher

11. Below I present a number of statements about the reasons which may have led you to using wood as a fuel.

Please circle one number on each line below

	Strongly disagree	Disagree	Neither agree or disagree	Rather agree	Strongly agree
(a) I have always used wood as a fuel	1	2	3	4	5
(b) Wood is cheaper than other fuels	1	2	3	4	5
(c) Burning wood in a specially designed boiler does not pollute the environment	1	2	3	4	5
(d) Burning wood in a specially designed boiler produces small amounts of ash	1	2	3	4	5
(e) Burning wood in a specially	1	2	3	4	5

designed boiler is a modern way of heating my house					
(f) In comparison with boilers for other fuels, I found the boiler which burns wood financially attractive	1	2	3	4	5
(g) Possibility of getting subsidy payment	1	2	3	4	5

This question attempted to disclose if in the respondent's opinion the environmental reasons played a significant role among other reasons that might have influenced their volitional control.

12. Which of the following environmental problems should be paid most attention?

Pick five most important problems. '1' gets the most important problem, '2' the second most important problem, etc, '5' the least important problem.

excessive noise

landscape protection

air pollution

quality of water

pollution in food

radioactive pollution (nuclear power stations, transport and disposal of radioactive waste)

pollution in rivers

global warming (greenhouse effect)

ozone hole

decline in plant and animal species

growths of the world's population

acid rain

devastation of rain forests

desertification

total exploitation of the world's stock of coal, oil and gas

The goal of this question was to elicit whether environmental problems such as air pollution and acid rain were of the deepest concern to the respondents and could influence their intention to perform environmentally sound decision as it is described in Figure 6.2.

6.5 Questionnaire for People who Live in Similar Conditions (Area) and Use Other Domestic Fuels Than Fuel Wood.

The design of the questionnaire only differed in questions 7 – 9.

7. What are, in your opinion, advantages of the fuel you use?

The goal was to find out what why they preferred the fuel they were using to other fuels.

8. What do you think of wood as a fuel?

Advantages (A):

Disadvantages (D):

The purpose was to collect information about the respondent's awareness of wood as a fuel.

9. Have you ever heard about specially designed boilers burning wood?

The purpose was to collect information about the respondent's awareness of wood as a fuel.

I translated the questionnaire 1 and 2 into Czech.

6.6 Field Work

6.6.1 Finding Respondents

As I decided to conduct the interviews before the usual heating season started, I postponed the realisation of the third questionnaire to winter, when, I assumed, it would be easier to contact the people who managed the heating appliance in operation.

For the potential interviewees of the questionnaire 1 I used a list of 19 customers and domestic users of the 'Verner boiler' I obtained from a dealer and serviceman for the southern half of the North Bohemian Region. I sent identical letters to each of them describing the purpose of my research and asking them to meet me. Then I enclosed a calendar of days I was staying in the region (from 30 August to 12 September) in which they could mark days and hours that would be convenient for them to meet me. Finally I enclosed a stamped, self-addressed envelope (with my address in the region).

At first I only received three replies. Hoping that more replies would come later I arranged one interview by telephone in Brandov village in Krusne hory mountains and two interviews by post in Dolni Zalezly village. The first three interviews took place in Brandov. Brandov is a rural settlement lying in a mountain valley on the

border with Germany. The village was not supplied with gas and did not have a district heating system. The heating season there lasts 10 months according to interviewees, which is two months longer than the average. I interviewed three families in the village, out of which two used wood and one used light fuel oil as a domestic fuel. From the two users of wood only one family was on my original list of potential interviewees, the other family and the family of non-users were recommended to me by the first family.

The next two interviews with respondents from my original list took place in a less remote settlement of Dolni Zalezly. Dolni Zalezly is a village, lying in the river Elbe valley about 10 km from Usti nad Labem, a regional capital of the North Bohemian Region. Gas main has been recently built in the village but after the interviewees bought their wood fuelled boilers.

Next interviews were conducted in Sebuzin, a village lying in the river Elbe valley, about 6 km from Usti nad Labem. This settlement neither was supplied with gas, nor had a district central heating system. One respondent recommended me another family in the village who also owned the same boiler. One additional interviewee was found through chance contact. He owned a boiler for brown coal where he burnt a combination of coal and wood.

Next family with the Verner boiler agreed to give me an interview the same day and recommended me three more people in the village who owned the same type of a boiler. Several days later and after some problems with contacting the people I arranged interviews with two of them.

In the mean time I carried out an interview with a man who switched from brown coal to gas heating in Litomerice, a district town where I was based during the fieldwork.

Then I went to Usti nad Labem to interview my last interviewee. On the way I interviewed a man whom I found through a chance contact. He switched from brown coal to gas heating when his village was connected to a gas pipe.

6.6.2 Description of the Interviews

In Brandov the two families used the same type of boiler Verner P25 (25 kW). They had been using it for three and four years. Both families received subsidy payments that partially covered the purchase of their boiler. In one case the donation came from a forest company in which one family member was employed. Second family received a special donation provided by the Ministry of Finance for selected settlements in North Bohemia for cases when domestic users of fossil fuels switch to 'ecologically more suitable fuels'. The financial help represents maximum of 15,000 Kc (Euro 469) per one dwelling unit. The price of the P25 boiler in 1992 was approximately 18,000 Kc (Euro 563).¹ This financial aid was received by most of the other interviewees, including people who use gas and electricity.

These people had a very good access to fuel wood as there are forests in their immediate vicinity and the price they pay for wood was very low. However, as in all other cases, the preparation of fuel was very labour demanding. In their case they had to go to the forest to load logs (1 m long) on a lorry, then they have to transport it

¹ The price of P25 was 39000 Kc in 2003.

home and cut it in halves (maximal length of a log used for this kind of boiler is 500 mm). These two families participated in preparation of fuel together, including another family that I did not interview. Men obtained the wood from a nearby forest, brought it home, then cut it, divided it in three parts for each family and then, together with children and grandchildren, they piled it and let it dry. This preparation lasted one week a year (40 cubic metres of wood per each family). Families helped each other only in this case. The rest of interviewees obtained and cut their fuel individually.

Both families were very happy with the boilers, they found wood a more convenient, cheaper and cleaner fuel than brown coal and would like to buy the same appliance when they need to replace their current boiler in the future. The third family using light fuel oil was very disappointed with both the fuel and the brand new oil fuelled boiler. They received the financial aid too. They heat a house of two dwelling units with a boiler with output of 32 kW. The boiler cost them 60,000 Kc (financial aid was 2x15,000 Kc) and they paid 60,000 Kc for the fuel last winter. The boiler spent 2.4 times more fuel than they expected and the price of fuel increased three times since they bought the boiler. They decided to save money and buy a wood fuelled boiler.

In the first family in Dolni Zalezly the husband's job was to buy and prepare wood and the wife looked after the stoves because his job involved a lot of travelling. I found it very interesting that this family started to stock fuel wood (in their garden) three years before they bought the boiler. So the wood they burnt was very dry and they needed to fill up the stock only occasionally. They were also very happy and

although the end of the gas main was in front of their house they had no intention of changing the boiler.

The second family in this village was a different case. The owner of the boiler was a lady in her seventies who had to manage the boiler on her own for two years during which her son tried to recover from a sudden illness that left him partially paralysed. He could manage the boiler and preparation of fuel on his own, using just one hand. Although she was happy with the efficiency of the boiler, she would find it more convenient for them to use gas. The reason was partially because she, as well as a large proportion of all interviewees, was extremely disappointed with finding a reliable supplier of wood. She was unable to find anybody who would be able to supply her with a required amount of fuel wood of good quality in a short time without the need of organising her own transport.

In Sebuzin I interviewed a wood burner who complained about the appliance. However, it was revealed during the interview that he often burnt fresh and therefore wet wood as he could not succeed in making a sufficient stock of fuel in advance. He knew that dry wood was a basic requirement for an optimal operation of the appliance but he could not find a reliable wood supplier.

In Sebuzin I also carried out an interview with a single woman who was a pensioner in her late fifties. At the beginning she was very disappointed because of problems with the wood supply but later she found a more reliable company. She hoped that in winter she could work on making a large stock of fuel. As far as the preparation of fuel was concerned she was entirely dependent on the help of her son and his family.

Next I interviewed an elderly couple of two pensioners, who were the oldest respondents in this sample. The man, 80 years old prepared the fuel.

In Usti nad Labem (approx. 100,000 inhabitants) I carried out an interview with a man (36 years old, the youngest among the respondents), who lived in the city centre and combined electrical heating with wood fuelled heating. Surprisingly, he did not find it difficult to obtain fuel wood. He cut logs himself.

6.7 Analysis of Answers

Altogether eight people using wood as a domestic fuel and four who did not use wood were interviewed. All interviewees who used wood as a domestic fuel in my sample decided for a new boiler because they needed a replacement for their old boiler. The old boilers burnt lignite. The reasons why they decided for wood burning boilers were more complex. Most of the interviewees showed some degree of environmental awareness. However, environmental problems did not get a priority by most interviewees. They were named among other social problems. In six cases they reported that environmental problems resulting from air pollution caused by burning fossil fuels (smog, acid rain, landscape and forest damage) represented the major environmental problems in the region (Part 3, question 3). Nevertheless when they were asked to choose among fifteen environmental problems five to which most attention should be paid, air pollution was mentioned only once as the most important problem and acid rain was not mentioned as the most important problem at all (Part 4, question 12).

Environmental reasons as factors influencing the interviewees' decision to use wood played a significant role. The fact that they were buying an environmentally friendly technology was a decisive factor for four of them and influenced them positively in another three cases. However, factors such as price, small amount of ash and possibility of getting subsidies influenced them at least as much. Most of them received a financial help of 15,000 Kc per dwelling unit which they claimed after they purchased a new, 'environmentally suitable heating appliance'.

Most of the interviewees found the new boiler more efficient, cleaner and easier to manage than the previous appliance. Some of the interviewees reported almost a 'personal relationship' with wood. They found the heat originating from wood 'more pleasant than other heat' although it burnt in their cellar and heat was transferred via their local central heating system. People who were not fully satisfied with the operation of the boiler were aware of the fact that it was at least to some extent due to a high content of water in wood they used. As far as fuel availability was concerned, except for people who lived in an immediate vicinity of a forest and were employed in forestry or at least knew people who worked in forestry, all interviewees complained about difficulties with obtaining fuel wood. They also complained about unreliability of suppliers, bad organisation of supply, heavy labour in connection with managing the fuel and the necessity of buying extra equipment such as a chain saw. The full questionnaire with answers is enclosed as Appendix III.

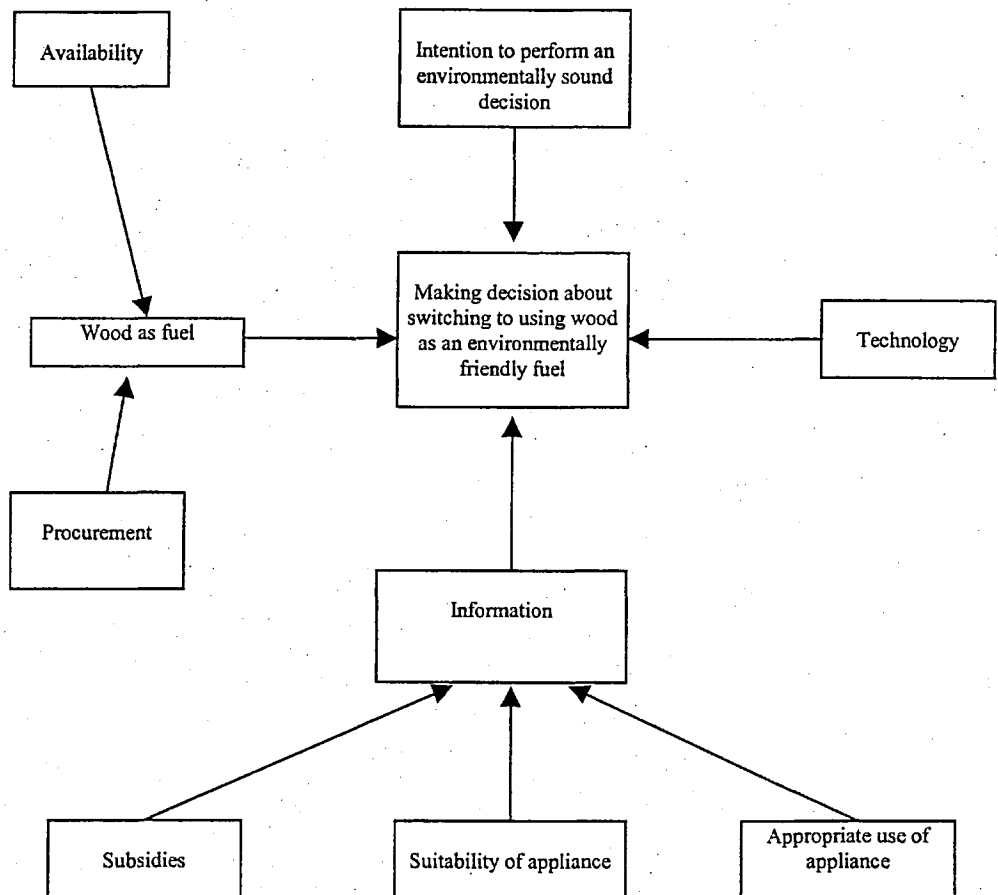
6.8 Conclusion

In practice, the method of survey appeared to be more difficult than expected, and the results can only be regarded as provisional. My original intention was to interview at

least 10 people who used wood and 10 people who did not use wood for the purpose of the pilot survey. In this respect the pilot survey only partially satisfied the needs of my research, particularly as far as users of fuels other than wood were concerned. The method of choosing the interviewees changed significantly because of lack of replies from the original potential interviewees.

The results of the pilot survey suggested that when individuals were making decisions about switching to using wood as an environmentally friendly fuel they often did it with the intention to perform an environmentally friendly decision. This is in an agreement with the adapted Fishbein's model as it is described in 6.2. However, environmental considerations did not play the decisive role. Environmental awareness influenced them along with strong influences of the low price of the fuel and the opportunity to receive a subsidy. Such subsidies were then only available in listed villages across North Bohemia. It brought me to a conclusion that the opportunity to receive a subsidy and information on this subject might generally represent a highly important factor for the development of the use of wood in the Czech Republic. Other factors that played an important role for the respondents' decision and could apply more generally were the information on suitability of the appliance and information on the correct use of the appliance. Correct use of a suitable appliance is also crucial for the technology to operate in an environmentally friendly way. By adjusting the Figure 6.4 a model can be drawn showing the factors that influence the use of wood as a domestic fuel:

FIGURE 6.4: Factors That Take Part in the Process in Which Wood is Used as a Domestic Fuel



An important finding is the crucial role of information available for consumers, particularly information on where to find wood, how to handle it and how to use it in an environmentally friendly way. The interviewees often mentioned that they seldom used their appliance at the maximum output, a situation that consequently leads to the increase of pollution. This highlights the importance of efficient energy management within households. Two aspects of household energy management need to be considered. The first is the right choice of a heat-generating appliance with a suitable output. This is crucial for generating heat effectively and without polluting the environment. The second aspect is the way in which the appliance is managed. The

correct choice of the fuel not only saves its overall consumption, but it also extends the life of the appliance itself and is also beneficial to the environment. It seems that the task of harmonising these factors can neither be successfully accomplished solely at the level of individual household nor at the interface between producers of technology and their customers.

Observing the factors determining the decisions about using the wood as a domestic fuel it became apparent that not all of them could be effectively addressed by typical business-style actions. Or, more precisely, not all issues that have arisen from my observation could be successfully tackled by economists and technologists. It particularly applies to dissemination of information on the use of the appliance that would consequently lead to a correct use of the appliance and procurement of wood. The respondents of the pilot survey regarded access to information, availability of and information on subsidies, wood procurement and the economic aspects of wood burning as crucial factors influencing their decisions to use the wood as domestic fuel. The first three factors can be strongly influenced by government actions.

The outcome of the pilot survey suggested that there might be links between the successful use of wood as a renewable energy source in households and the government policy. This outcome as well as the physical and logistic difficulties experienced when conducting a more formal survey based on my pilot survey caused a shift in my further research. I decided to divert my attention from more in-depth analysis of the reasons for choosing wood as a domestic fuel at the individual level and analysing the factors from a consumer point of view. Instead I turned my attention to the extent to which wood is represented in government energy policy. I

tried to find an answer to the question of how the policy addresses the issues that the interviewees in the pilot survey identified as serious factors affecting the use of wood as a domestic fuel.

CHAPTER 7: BIOMASS POLICIES IN THE CZECH REPUBLIC

7.1 Introduction

The results of the pilot survey suggested that factors other than their considerations for the environment had played a crucial role when consumers were making a decision about the switch to wood as a fuel. The opportunity to receive financial subsidies represented a very important factor. As a result of the analysis of the interviewees' answers it became clearer what helps to make the 'correct' decision about the switch to a new fuel. It also became apparent that switching to this technology does not have to mean that it would be operating as environmentally sound technology. For its users it is necessary to have access to suitable information about all the factors affecting the process in which wood is used as a renewable energy resource. That includes information about the type of technology appropriate to users' specific situations and the mode in which it should be used, and also information about available financial incentives relevant to each case-specific circumstances. Another crucial question was the immediate availability of fuel wood.

It was considered as very likely that these issues could not be effectively resolved by the simple market interaction between technology producers and consumers. It also became apparent that the question of fuel availability and procurement cannot be dealt with on a general basis of only estimating theoretical stocks of fuel wood in a given area. It requires more elaborate, detailed and more long-term planning of the source of wood taking into consideration both large and small consumers of wood in a given area. Again, it did not seem possible for this to be

resolved by relying on the interaction between suppliers and consumers alone. It required other participants in the processes: The government, local authorities and non-governmental organisations.

This chapter summarises the government's policies directly relating to the use of wood as an energy resource that have been developed since 1995 (parts 7.2 and 7.3). It also analyses what issues identified in Chapter 6 (the pilot survey among biomass users in 1996) have been addressed and how the public responded to policy initiatives. Part 7.4 describes examples of activities of non-governmental organisations that seek to promote biomass as a renewable energy resource.

The Czech Republic was among the signatories of the Ministry Conference on Protection of Forests in Europe, which took place in 1993 in Helsinki (Pondelickova 2000). The signatories decided to enforce the general principles of sustainable management in European forests. One of the principles the signatories agreed to follow emphasised the potential of wood as the main product of forests: '(I)t can to a great extent substitute products from non-renewable resources, provide energy and many more products, services and functions which are necessary for satisfying social wellbeing and have a positive effect for the environment in near future. The signatory countries and the European Union should also support exploitation of wood as a renewable resource of energy while using technologies with low emissions of pollutants. It should contribute to sustainable development through environmental protection and reduction of greenhouse gases.'

7.2 Energy Policy in the Czech Republic

The Energy Policy document¹ is a basic document expressing goals for the energy economy (in the general sense of 'how energy is managed in the state'). It is the responsibility of the Ministry of Industry and Trade and is an 'open' document with an outlook for 15-20 years. The Ministry submits the document to the government. When the government approves it then it is assessed at a minimum of two-year intervals. The government is informed about the achievements of the energy policy and suggests changes.

The energy policy of the Czech Republic is based on that of the European Union. In the area of renewable energy resources the document sets out as a goal 'to create a functional, non-discriminatory, transparent and motivating system of support of possible savings of energy, exploitation of renewable energy resources and combined heat and electricity.' More specifically the document suggests: 'First, to implement the State Programme for Support of Energy Savings and Exploitation of Renewable Energy Resources.'² It points out that the processes of the programme's implementation have to be fair and transparent. It must not lead to distortion of competition in the market for energy. Subsequently the document requires 'implementation of the national programmes in this area that are a consequence of the Energy economy Act,³ including the system of financing. 'It should be controlled so that the energy and ecological contributions were cost effective and should be within the means of the state budget.... The systems of support will be compatible with similar systems implemented in EU member countries.'(Energy Policy 2000) Among renewable energy resources, biomass

¹ Document passed by the government of the Czech Republic on 12 January 2000, Number 50.

² According to the government's decision Number 480/1998 Coll., *Zakony Energeticka politika* [online]. Available from [http:// www.energetik.cz](http://www.energetik.cz). [Accessed on 10 May 2002].

receives much attention. It is mentioned first: 'Renewable energy resources cannot play a crucial role within the time horizon of this energy policy but their exploitation will represent an important regional and local contribution (to production of energy from renewable energy resources, edited by BJ). It is especially biomass (straw, hay and wood waste) and development of generation of energy from energy crops but only where the transport costs are within the limits of cost effectiveness. It is also possible to exploit set-aside agricultural land for cultivation of fast growing energy plants.' Hydro power plants, wind power stations, solar systems and geothermal energy are also mentioned but with a comparatively smaller emphasis.

'The aim is to increase the share of renewable energy resources in the total consumption of primary energy resources from the current 1.5 per cent to 3-6 per cent by 2010 and to 4-8 per cent by 2020. According to estimates carried out by the Czech Energy Agency,' says the Energy Policy document, 'the increase of the share of renewable energy resources (electricity and heat) to 6 per cent by 2010 would require an investment of CZK 242 billion (Euro 7.6 billion) and CZK 42.5 billion (Euro 1.3 billion) of incentives (from non budget sources such as the PHARE programme).' It is also argued in the document that if the renewable resources were to be exploited to the full potential as it is estimated by the Ministry for the Environment, the financial investments would represent CZK 1,250 billion (Euro 39 billion) (Energy Policy 2000). However, the Czech government is currently preparing a new Act in support of electric and thermal energy generated from renewable energy sources. The Bill that should come into force in May 2004 sets the goal of achieving an 8 per cent share of electricity in gross electric power consumption

³ Act number 406/2000 Coll. passed on 25 October 2000, *Zakony*[online]. Available from

by 2010. Financial support system is discussed for renewable electricity generation. Support for thermal energy generation is yet to be resolved (Zeman 2003).

7.3 Government Support Schemes

Until very recently and certainly in mid-1990s when this research started there were no government support schemes intended to stimulate a switch at the household level from a non-renewable energy resource to wood. The only available financial assistance was based on a decree⁴ allowing people in specific settlements of northern Bohemia to apply for a financial contribution of maximum of CZK 15,000 (Euro 500) per household.

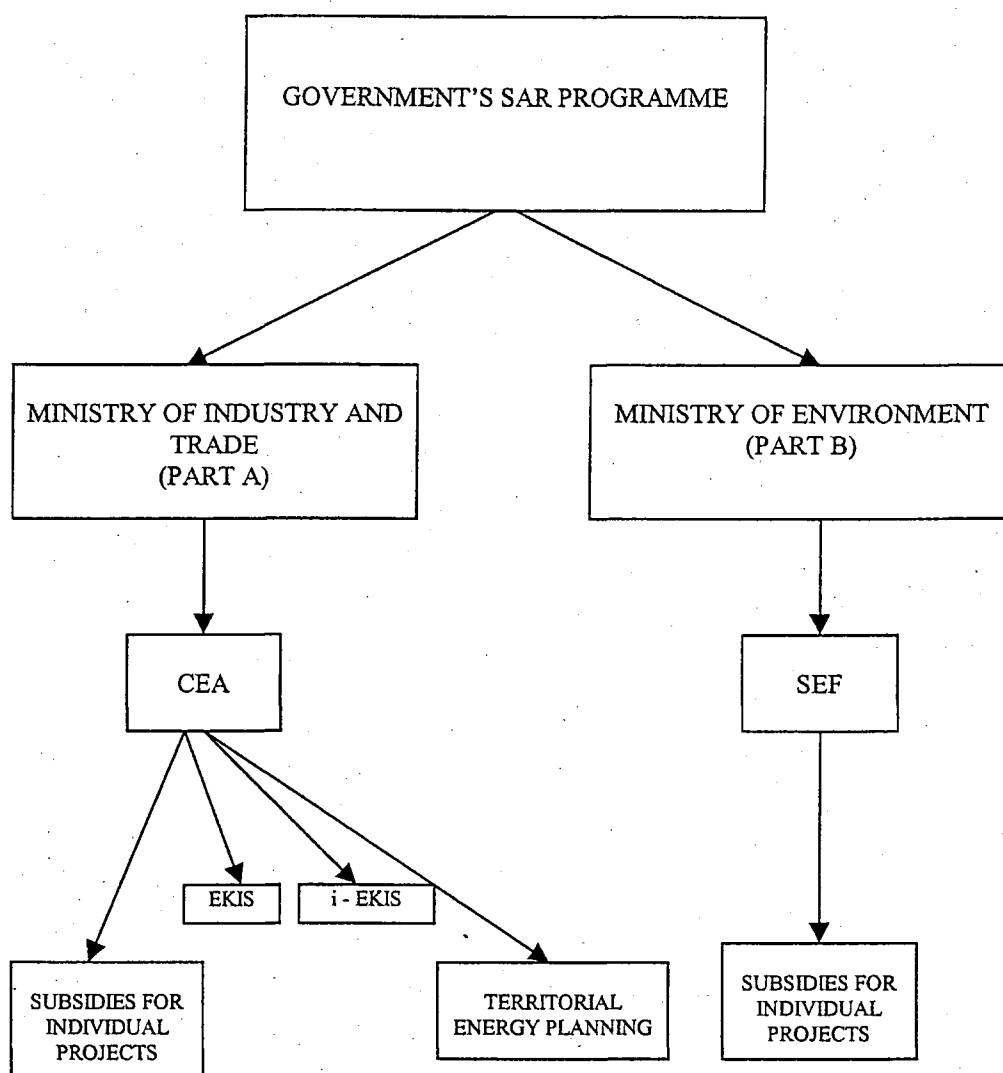
The State Programme for Support of Energy Savings and Exploitation of Renewable Energy Resources ('Savings and Renewables programme, thereafter SAR Programme), consisting of four parts, was adopted in November 1999 and launched in 2000. Four different ministries are responsible for implementation of its four individual parts:

1. Part A: Ministry of Industry and Trade – via its subsidiary body the Czech Energy Agency (CEA)
2. Part B: Ministry of Environment – via its subsidiary body the State Environmental Fund
3. Part C: Ministry of Agriculture
4. Part D: Ministry of Regional Development

I analysed Part A and Part B of the SAR Programme because they directly relate to the use of biomass as a renewable energy resource used by individuals.

<http://www.energetik.cz>. [Accessed on 10 May 2002].

STRUCTURE OF GOVERNMENT SUPPORT SCHEMES UNDER THE SAR PROGRAMME



7.3.1. Part A of the SAR Programme Run by the CEA

This Programme is focused on the implementation of energy efficiency means in production, distribution and consumption of energy, better utilisation of renewable and secondary energy resources and co-generation of heat and electricity. The emphasis is placed on the encouraging of higher efficiency of

⁴ Decree of the Ministry of Finance about financial contributions to citizens in selected areas of the Czech Republic when they switch from heating their households with solid

energy use, particularly in industry through dissemination of modern innovative technologies and management processes. Attention centres on projects, which are highly cost-effective, support for consultancy and education and propagation of means that lead to an economical use of energy and of renewable and secondary energy resources by the wide public.⁵ Through this programme and its sub programmes there are funds available for community projects such as demonstration projects focused on combined heat and electricity generation from biomass and demonstration projects of low energy buildings. There is also a sub programme supporting advisory services for the wider public, organisation of educational activities provided free of charge and focused on the economical use of renewable energy resources. For example i-ekis, is an Internet advisory centre that operates as a part of this sub-programme. It is a free Internet advisory service focused on reduction of energy consumption and it is a part of the advisory service EKIS CEA (a network of Energy Consultancy and Information Centres of the Czech Energy Agency).

CEA

This is an organisation founded by a decision of the Minister of Industry and Trade in 1995. Czech Energy Agency replaced Energy Agency of the Czech Republic. CEA initiates, supports and realises activities that lead to energy savings and reduction of negative impacts of consumption and transformation of all types of energy on the environment. One of the main tasks of CEA is also preparation realisation and consistent assessment of state programmes that are focused on implementation of energy efficient appliances and reduction of

fuels to more environmentally friendly fuels, valid from 1 March 1992.

⁵ Decision number 169/2000 of the Secretary of the state for the Industry, part A, The State Programme for support of energy savings and the exploitation of renewable energy resources, Chapter I.

negative impacts of energy processes on the environment. CEA's activities are divided into five areas:

- I. Energy saving means which lead to increase of energy efficiency use in both domestic and industrial areas (technological measures such as insulation, measuring and regulation of generation of energy, supply of heat and hot water).
- II. Combined heat and electricity generation (industrial power engineering and non-traditional sources).
- III. Equipment for generation and distribution of energy (heat pipes and their hydraulics, industrial power engineering).
- IV. Renewable and secondary resources of energy, such as biomass, solar energy, heat pumps, hydro energy, wind energy and co-generation.
- V. Territorial energy planning.

Renewable and Secondary Resources of Energy - History of CEA in Biomass Related Projects

According to Selong (1998), annual programmes have been aimed at reduction of consumption of fuels and energy in the Czech Republic since 1991. The programme of free-interest loans (with the obligation to pay the loan back within three years of realisation of the project) for projects exploiting renewable energy resources was open both to the general public and business. The projects, which were prioritised during the period 1991-1995, were focused on production of electricity from renewable energy resources. Financial resources allocated to this programme were limited to CZK 35 million (Euro 1.1 million) every year. Between 1991-1995, 332 projects were awarded free-interest loans. Incentives given to small hydro power stations represented 60 per cent, co-generation units 25 per cent and wind power stations, heat pumps and solar equipment 15 per cent.

The new State Programme of Savings of Fuel and Energy was announced in 1996. In the same year the Energy Agency ceased to exist and Czech Energy Agency was established. This transformation did not simply mean a change of the name of the organisation. Selong (1998) points out that the management of the CEA brought a new approach towards the issue of energy savings. The new CEA focused on demonstration projects supported by state subsidies which, consequently should lead to involvement of more general public through information campaigns. In 1996 a set of requirements on projects was produced. Criteria for projects in the non-industrial sector were set in 1996 and a programme for industry was prepared separately. Thirty-nine projects were supported in 1996 in both industrial and non-industrial sectors, that were awarded CZK 29 million (Euro 0.9 million). They included 1 heat pump, 18 combined heat and electricity projects and 16 small hydro power stations; a project on combustion of biomass appeared for the first time. 31 projects totalling CZK 40 million (Euro 1.25 million) were supported in 1997, out of which only one was a project on combustion of biomass.

The number of applicants rose sharply following the change (Selong 1998). For example the number of applicants in 1996 was eight times higher and in 1997 ten times higher than the number of grants available. The shift from interest-free loans to more popular non-returnable grants apparently spurred the interest in these schemes. However, the current State Programme of Savings of Fuel and Energy excludes individuals as potential applicants.

EKIS

Early in this study it was concluded that it is very important to spread relevant information about the use of biomass as an energy resource (outcome of the

biomass-users' questionnaire). In order to evaluate the significance of an information source for biomass users I observed the quantity and regional distribution of EKIS centres. They are a network of Energy Consultancy and Information Centres. They receive funds from the Czech Energy Agency.

According to information published by i-EKIS in 2002, there were 60 centres of EKIS, out of which 54 provided advice on renewable and secondary energy resources.

Distribution of EKIS centres that advise on renewable energy resources according to region and district is displayed in Table 7.1.

TABLE 7.1: Distribution of EKIS Centres that Advice on Renewable Energy Resources According to Region and District.

	Region ^a , area ^a , (NUTS III ¹⁾) population ^b	Area of exploit- able forests ²⁾ [hecta- res]	Area of exploita ble forests per capita [hecta- res]	Name of district (NUTS IV ¹⁾)	Town with EKIS
1	Jihocesky kraj, 10,056 sq. km 630,168	280,087	0.44	Ceske Budejovice	Ceske Budejovice ^c
				Ceske Budejovice	Ceske Budejovice
				Cesky Krumlov	Cesky Krumlov
				Jindrichuv Hradec	Jindrichuv Hradec
				Jindrichuv Hradec	Suchdol nad Luznici
				Strakonice	Blatna
				Tabor	Tabor
2	Jihomoravsky kraj, 7,067 sq. km, 1,133,916	131,165	0.12	Blansko	Blansko
				Brno	Brno
				Brno	Brno
				Brno	Brno
3	Kraj Vysocina, 6,925 sq. km, 521,212	193,000	0.37	Vyskov	Vyskov
				Havlickuv Brod	Svetla nad Sazavou
				Jihlava	Jihlava
4	Karlovarsky kraj, 3,315 sq. km, 306,799	87,000	0.28	Zdar nad Sazavou	Zdar nad Sazavou
				Karlovy Vary	Dalovice
5	Kralovehradec -ky kraj, 4,757 sq. km, 554,348	102,000	0.18	Hradec Kralove	Hradec Kralove
				Trutnov	Trutnov
6	Liberecky kraj, 3,163 sq. km, 430,769	93,000	0.22	Jablonec nad Nisou	Jablonec nad Nisou
				Liberec	Liberec
7	Moravsko- slezsky kraj, 5,555 sq. km, 567,758	162,000	0.29	Karvina	Cesky Tesin
				Novy Jicin	Novy Jicin
				Ostrava	Moravska Ostrava
				Ostrava-mesto	Ostrava
				Ostrava-mesto	Ostrava
				Ostrava-mesto	Ostrava
				Ostrava	Ostrava-Poruba

8	Olomoucky kraj, 5,139 sq. km, 642,465	138,000	0.21	Olomouc	Olomouc
				Prerov	Prerov
				Sumperk	Sumperk
9	Pardubicky kraj, 4,519 sq. km, 510,079	116,000	0.23	Pardubice	Pardubice
				Pardubice	Pardubice
				Svitavy	Svitavy
10	Plzensky kraj, 7,580 sq. km, 553,741	236,000	0.43	Klatovy	Susice
				Plzen-mesto	Plzen
				Plzen-sever	Horni Briza
				Rokycany	Rokycany
11	Stredocesky kraj, 11,014 sq. km 1,129,627	195,083	0.17	Kladno	Kladno
12	Ustecky kraj, 5,335 sq. km, 826,380	113,000	0.14	Litomerice	Roudnice nad Labem
				Usti nad Labem-mesto	Usti nad Labem
13	Zlinsky kraj, 3,985 sq. km, 1,277,095	136,000	0.11	Kromeriz	Kromeriz
				Uherske Hradiste	Uherske Hradiste
				Vsetin	Valsske Mezirici
				Vsetin	Vsetin
				Zlin	Zlin
				Zlin	Zlin
14	Kraj Praha, 496 sq.km 1,178,576	90,000	0.08	Praha 1	Praha 1
				Praha 2	Praha 2
				Praha 3	Praha 3
				Praha 4	Praha 4
				Praha 5	Praha 5
				Praha 7	Praha 7
				Praha 8	Praha 8

a) Available from [http:// www.mestaobce.cz](http://www.mestaobce.cz) [Accessed on 12 June 2002].

b) Data valid in March 2001, source CSU (Czech Statistical Office) *Preliminary results of scitani lidu domu a bytu* [online]. Available from <http://www.mestaobce.cz> [Accessed on 12 June 2002].

c) Names of districts and capitals of the district are often the same in the Czech Republic.

1) For explanation of NUTs see Appendix I.

2) Forest Management Institute (2000).

Table I shows that there are EKIS centres in all 14 regions. It is not entirely clear from the available information whether all EKIS centres that advise on renewable energy resources have full information in biomass or wood in general. Even if they do not specialise in biomass, all centres have Internet access which

theoretically means that they can provide their clients with information from i-EKIS.

There are 77 districts in the CR. In 54 of them people can visit an EKIS centre and look for information on renewable energy resources. Five centres operate as a part of 'town advisory centres' that are established by the local authority but very often they are parts of private firms.

If we leave aside Prague, Jihocesky region and Moravskoslezsky region have the greatest number of EKIS centres – each of them has 7. The situation is different in three other regions, belonging to the so-called 'Black Triangle' – an area suffering from heavy industrial pollution. In Karlovarsky, Ustecky and Liberecky regions taken together, with the combined population of 1,800,000, there are only 3 EKIS centres. What might be the reasons for the 'high density' of EKIS centres in Jihocesky region? First, it is a region, which has the highest amount of economically exploitable forest. Then, according to number of opinion polls, Jihocesky region is perceived by Czechs as the most beautiful and least polluted region of the Czech Republic. (Drbohlav 1991). These features have attracted a number of people from other regions to move to Jihocesky region. People might be interested in taking measures to preserve it. It is also a region with the new and controversial Temelin nuclear power station. It is possible that this makes people more aware of the environmental conditions that surround them. Jihocesky region and its capital Ceske Budejovice in particular have a history of environmental activism that dates back to the pre-1989 period (Fagin *et al.* 2002). People here might be generally more interested in environmental issues. There are also several environmental NGOs operating in this region. Another factor might be the fact that Jihocesky region shares the border with Austria where, especially in Upper

Austria, wood is commonly used for energy purposes. A number of municipalities in Jihocesky region co-operate with their partner municipalities in Upper Austria.

The three north Bohemian regions, however, are regions with a comparatively smaller area of exploitable forest cover. It is also an area where brown coal is mined and used for heating. Therefore people might not be willing to change the fuel for heating their houses. This explanation, on the other hand, does not apply for Moravskoslezsky region, where coal is also mined and where EKIS centres are numerous.

In order to understand whether the EKIS centres play a significant role when people decide to switch from other fuels to biomass I compared the regional distribution of EKIS centres with the average exploitable forest cover per capita and small biomass projects that received subsidies through SEF in 2001 (Table 7.2).

TABLE 7.2 Distribution of EKIS Centres and Small Biomass Projects Funded by SEF in 2001.

	Region ^a , area ^a , (NUTS III ¹⁾) population ^b	Number of EKIS centres in 2001	Area of exploita- ble forests ²⁾ [hecta- res]	Area of exploitable forests in hectares per capita in the Czech Republic	Small projects with biomass subsidised by SEF (1 A a and b) in 2001	
		Number of EKIS centres per 100 thousand inhabitants			Natu- ral per- sons	Commu- nal projects
1	Jihocesky kraj, 10,056 sq. km, 630,168	7 1.1	280,087	0.44	20	4

2	Jihomoravsky kraj 7,067 sq. km, 1,133,916	5 0.4	131,165	0.12	11	0
3	Kraj Vysocina, 6,925 sq. km, 521,212	3 0.6	193,000	0.37	0	0
4	Karlovarsky kraj, 3,315 sq. km, 306,799	1 0.3	87,000	0.28	0	0
5	Kralovehradecky kraj, 4,757 sq. km, 554,348	2 0.4	102,000	0.18	9	0
6	Liberecky kraj 3,163 sq. km, 430,769	2 0.5	93,000	0.22	2	1
7	Moravskoslezsky kraj, 5,555 sq. km, 567,758	7 11.2	162,000	0.29	5	3
8	Olomoucky kraj, 5,139 sq. km, 642,465	3 0.5	138,000	0.21	13	3
9	Pardubicky kraj 4,519 sq. km, 510,079	3 0.6	116,000	0.23	0	0
10	Plzensky kraj 7,580 sq. km, 553,741	4 0.7	236,000	0.43	5	0
11	Stredocesky kraj 11,014 sq. km 1,129,627	1 0.01	195,083	0.29	9	2

12	Ustecky kraj 5 335 sq. km, 826,380	2 0.2	113,000	0.14	3	0
13	Zlinsky kraj 3 985 sq. km, 1,277,095	6 0.5	136,000	0.11	0	0
14	Kraj Praha 496 sq. km 1,178,576	8 0.7	90,000	0.00	0	0
Average number of EKIS centres		3.9				
Average exploitable forest cover per capita				0.23		

Source:

a) Available from [http:// www.mestaobce.cz](http://www.mestaobce.cz) [Accessed on 12 June 2002].

b) Data valid in March 2001, source CSU (Czech Statistical Office) *Preliminary results of scitani lidu domu a bytu* [online]. Available from [http:// www.mestaobce.cz](http://www.mestaobce.cz) [Accessed on 12 June 2002].

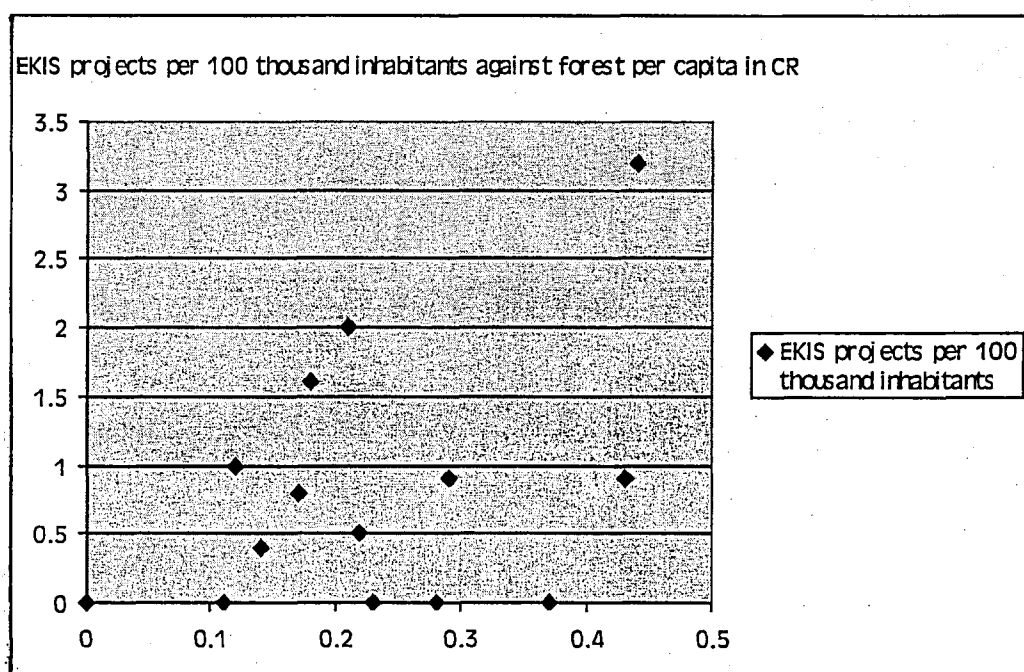
c) Names of districts and capitals of the district are often the same in the Czech Republic.

1) For explanation of NUTs see Appendix I.

2) Forest Management Institute (2000).

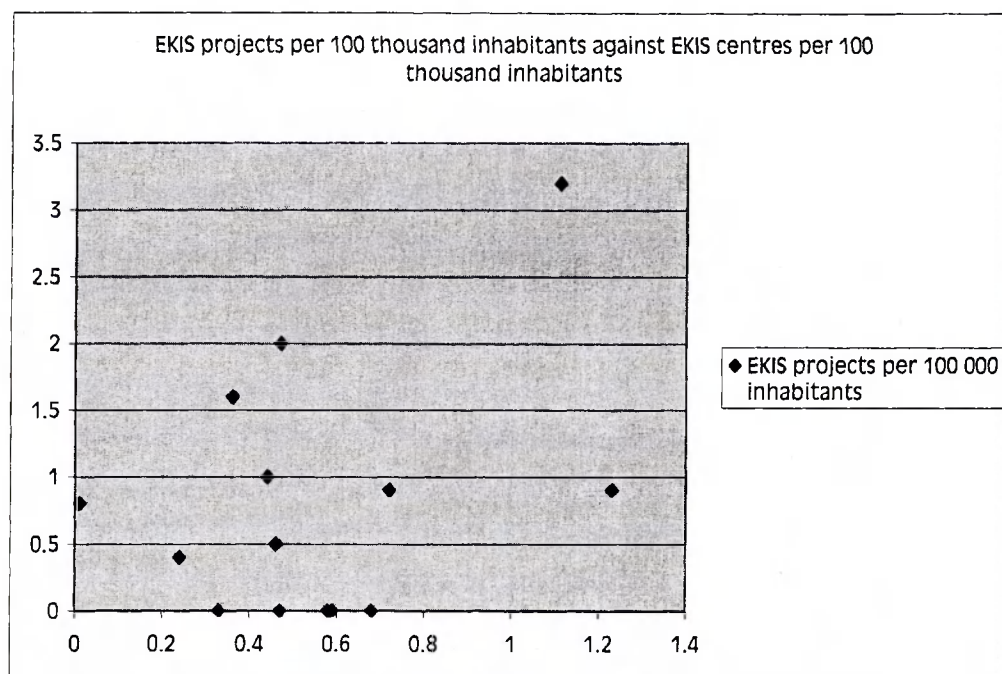
GRAPH 7.1:

Number of EKIS Projects per 100 Thousand Inhabitants Against Forest Area per Capita in the Czech Republic



GRAPH 7.2:

Number of EKIS Projects per 100 Thousand Inhabitants Against EKIS Centres per 100 Thousand Inhabitants in the Czech Republic.



Jihocesky region follows the same pattern as in relation to distribution of EKIS centres. It has the most projects as well as the highest forest cover and the highest number of EKIS centres in the region. Relations in the rest of the regions are less clear. The second highest number of projects is in Olomoucky region. There are only three EKIS centres in this region and less than average forest cover per capita. Stredocesky region comes third as far as the number of projects is concerned with just one EKIS centre and less than average exploitable forest cover per capita. However, Stredocesky region is an area surrounding the capital Prague. The capital represents a centre where people from Stredocesky region commute to work and seek information, therefore Prague with eight EKIS centres and very little source of wood should be considered together with Stredocesky region. Region Vysocina has a high forest cover per capita and no biomass projects.

I compared regions which have more than average number of EKIS centres and regions with more than average forest cover per capita (Table 7.3) with the number of small biomass projects subsidised by SEF. There are more projects in regions with more EKIS centres than in regions with high forest cover. It is a comparison of regions, which has less than average number of EKIS centres and regions with less than average forest cover per capita in Table 7.4. There are more projects in regions with less forest than average than in regions with equal or more than average forests cover per capita. There are fewer projects in regions with smaller number of EKIS centres than in regions with higher number of EKIS centres. This means that the distribution of biomass projects relates less to the availability of fuel than to the number of EKIS centres. Consequently this can also mean that better informed people decide for biomass more than people who may have lived in areas with more source of fuel from a forest do.

TABLE 7.3 A Comparison of Regions According to the Number of EKIS and Forest Cover per Capita

Region which has equal or more than average number of EKIS centres (average is 3.9)	Number of projects	Region which has equal or more than average exploitable forest cover per capita (0.23 hectares)	Number of projects
Jihocesky	24	Jihocesky	24
Jihomoravsky	11	Vysocina	0
Moravskoslezsky	8	Karlovarsky	0
Plzensky	5	Moravskoslezsky	8
Zlinsky	0	Plzensky	5
Praha + Stredocesky	11	Pardubicky	0
Total number of projects	59		37

TABLE 7.4 A Comparison of Regions According to the Number of EKIS and Forest Cover per Capita

Region which has less than average number of EKIS centres (average is 3.9)	Number of projects	Region which has less than average exploitable forest cover per capita (average is 0.23 hectares)	Number of projects
Vysocina	0	Zlinsky	0
Karlovarsky	0	Ustecky	3
Kralovehradecky	0	Praha + Stredocesky	11
Liberecky	3	Olomoucky	16
Olomoucky	16	Liberecky	3
Pardubicky	0	Kralovehradecky	9
Praha + Stredocesky	11	Jihomoravsky	11
Ustecky	3		
Total number of projects	33		53

Application of the Spearman Rank Correlation Coefficient

This discussion suggests that it is likely that the number of projects is related more closely to the number of information centres in regions than to the potential availability of wood. This association between the number of EKIS projects in regions and forests per capita and EKIS centres was tested using the Spearman rank correlation (Chalmers *et al.* 1986). Two sets of data represented first by the number of EKIS projects per 100 thousand inhabitants and the number of EKIS centres per 100 thousand inhabitants and second by the number of EKIS projects per 100 thousand inhabitants and the forest cover per capita in respective regions were (see more details in Appendix IV).

In both cases the Spearman rank correlation coefficient was compared with the critical values for the relevant sample sizes. Since the coefficient appeared to be close to zero it was concluded that in both cases there was no correlation between the two features under investigation.

More factors may participate in distribution of small biomass projects in regions than just the number of advisory centres and amount of wood. The procedure whose conclusion is that an applicant is awarded the subsidy from SEF is quite complicated as mentioned earlier in this chapter. It may attract more informed and educated people than are the majority of people who decide for biomass.

The physical proximity of local EKIS centres is important for people interested in using wood as a fuel. Wood is usually used as a fuel by village dwellers that are older and less well off than is the average. Internet⁶ is more a hobby of the young generation and therefore it may be very important for the users of wood to have an opportunity to visit EKIS centres. I sent a questionnaire to all EKIS centres in order to establish whether the biomass users seek information from the centres. My aim was also to learn what kind of information the biomass users look for.

Questionnaire for EKIS centres

The aim of this questionnaire was to find out to what extent people interested in wood as a fuel use EKIS CEA which are present in all fourteen regions of the Czech Republic and what questions they ask. There are currently 60 centres of EKIS, out of which 54 provide advice on renewable and secondary energy resources. Until recently the individual centres kept a diary of consultations they

⁶ There is evidence that the Internet is a source of information with a growing popularity among the Czech population. According to TNS Factum, in March 2002 28 per cent of

provided. I asked them (the 54 centres advising on renewable energy resources) via E-mail to use the diaries to answer following questions.

Question 1

How many questioners asked you questions about renewable energy resources?

Question 2

Out of these how many asked questions about biomass?

Question 3

How many questioners asked you questions that directly relate to heating with fuel wood?

Question 4

What proportion of the questioners represented individuals as opposed to community projects?

Question 5

Is the number of questioners who ask questions about fuel wood increasing or decreasing? Can you express annual changes in percentage?

Question 6

Please, put in order following areas of questions according to the frequency of the question and rank them from the most frequent to the least frequent question.

the most frequently asked question

- less frequently asked question
- even less frequently asked question
- least frequently asked question

- questions relating to combustion technology of wood (e.g. stoves, boilers)

adults in the Czech Republic accessed the Internet while in October 2001 there were just 26 per cent.

- questions relating to possible subsidies
- questions relating to procurement of wood (where get wood, how to prepare it for combustion)
- questions relating to the potential of wood in a concrete locality

In case the most frequently asked question and the second most frequently asked question differ from the four areas, please state what questions they are.

Question 7

How do you advertise your EKIS centre?

Table 7.5 Frequency of Answers.

	Technology	Subsidies	Procurement	Local availability of wood
most frequently asked q	8	2	0	0
less frequently asked q	3	7	1	1
even less frequently asked q	0	0	4	1
least frequently asked q	1	0	3	3
No such q ever asked				

Fifteen EKIS centres responded to my questionnaire (28 per cent). According to their answers, 46 percent of questions were about biomass out of 1,689 questions about renewable energy resources. Among the questions about biomass were 71 per cent that directly related to heating with fuel wood. Questions regarding fuel wood came mostly from individuals. All EKIS centres that responded answered that the number of questions asked about fuel wood were either the same or growing. One of the reasons why the interest in fuel wood is growing is obvious and clearly expressed by EAV Jihlava: '...the number of questioners-individuals is growing because the government's subsidies from the SAR Programme run by SEF...' JSM Hradec Kralove expressed the same idea and added: '... The number of questioners-individuals is growing but not because of environmental awakening. A substantial increment took place in the second quarter of 2002. It was caused by a massive advertising of the subsidies' programme which was launched by Atmos (producer of boilers). As a result, 30 applications were submitted during June 2002 only. Admission of applications was finished for this year because all financial resources for this year were consumed. Then the interest in biomass sharply dropped. We have the same experience when people apply for donations either when they want to use wood or other renewable energy resources. People are often willing to invest uneconomically just because they can get subsidies.' It is in agreement with the opinion expressed by Ajzen and Madden (Ajzen *et al.* 1985) that

'A behaviour may be said to be completely under person's control if the person can decide at will to perform it or not to perform it. Conversely,

the more that performance of the behaviour is contingent on the presence of appropriate opportunities or on possession of adequate resources (time, money, skills, co-operation of other people, etc.), the less the behaviour is under volitional control.'

According to respondents, questions relating to combustion technology of wood were the most frequently asked questions. Subsidies were less frequently asked questions. That suggests people were already well aware of the subsidies. Even less frequently asked questions were about procurement and least frequently asked questions were again procurement and local availability of fuel. Two EKIS centres stated that they have never received a query about either procurement or local availability of wood. One such centre was JHS HK. They responded that ,...nobody has ever asked about the potential of fuel wood in the region. When we raise this issue with our clients, they say that they have huge stock of dry fuel wood at home...'

i-EKIS

i-EKIS was founded in response to the SAR Programme (article VIII.C.1, item 'creation and development of database systems for efficient exploitation of energy and renewable energy resources'). The system functions as a database of questions and answers. It is freely accessible for the public on the Internet. The first question was asked on 20 August 2001 and until 19 August 2002 altogether 173 questions were asked and answered. Questions asked covered a wide range of subjects such as boilers, various ways of heating in buildings, insulation, energy audits, go-generation and financial sources. Distribution of questions relating to renewable energy resources is in Table 7.6.

TABLE 7.6 Questions Relating to Renewable Energy Resources Asked by the Public in the First Year of the Existence of the i-EKIS Information Database.

Area of question	Number of questions
Biomass	18
Subsidies in biomass technology	4
Availability of fuel	1
Solar energy	8
Heat pumps	9
Wind power stations	14
Hydropower stations	3

The relatively small total number of questions asked might be caused by the fact that it is a new information service. However, it can be also caused by a different factor. All questions and answers in the i-EKIS information database are accessible. A person who wants to make an enquiry can find a relevant answer among answers that have been already provided and therefore it is impossible to find a correlation between a growing interest in biomass and a growing demand for the information about this subject.

Territorial Energy Planning

The importance of energy management in the Czech Republic has not been until very recently recognised, although it has been a systematic element of managing municipal energy in the countries of the European Union.

The new Energy Economy Act comprises State Energy Policy⁷ that consists of aims of the state energy economy with the outlook on 20 years. It is drafted by the

⁷ § 3, State Energy Policy in Energy Economy Act Number 406/2000 Coll. passed 25 October 2000.

Ministry of Industry and Trade and then agreed by the government. Territorial Energy Strategy⁸ is based on the State Energy Policy. It comprises aims and principles of solutions on a regional level. It creates conditions for the use of energy in agreement with the needs of the economy and social development including environmental protection and economical use of natural sources of energy. Territorial energy plans are obligatory foundation for territorial planning. Territorial plans are documents that state limits for land use by commands and prohibitions and define areas for individual human activities within some limits such as a municipality. Municipalities are by law⁹ obliged to provide territorial plans.

So far territorial energy plans have not yet been developed on a large scale and their implementation might be hard. In 2001 SEVEN in co-operation with ENERGY Cities (France)¹⁰ organised a seminar 'Energy Policy of Czech Towns in Comparison with Towns in EU Countries' (Karnik 2001) in Jablonec nad Nisou. 39 town representatives, out of whom 5 were foreign representatives took part in the seminar. Although most of them supported the idea of energy plans, they found the inclusion of energy plans in the binding part of territorial plans as problematic. Any changes in the function and structure of parts of towns could be very expensive. Towns often have over expanded energy infrastructure that have a service life up to 50 years and these have not yet been paid. Karnik (2001) also points out that, 'at present, the most reliable consumers are owners of apartment houses. Other consumers - local business premises and industry – are unstable in the long-term prospect.'

⁸ § 4, State Energy Policy in Energy Economy Act Number 406/2000 Coll. passed 25 October 2000.

⁹ § 17 Building Act Number 50/1976 Coll.

¹⁰ An association of 88 European local authorities which acts to raise awareness of energy issues and the action of local authorities in this area.

Let us look at the case of Policka, a town where a new energy plan has been developed and its implementation is now being discussed. Policka is a town of 9,300 inhabitants in Pardubický region, district Svitavy. The town's energy plan is a document approximately 70 pages long. It summarises the overall characteristics of the town, comprising geographical climatic, population and housing data. There are also data on how the area is divided according to its energy consumption. One chapter of the document describes energy consumption in the town according to specific activities in the town and its surroundings. Another chapter is an analysis of the current situation in the energy distribution system, energy sources and supply of energy. The main part of the plan consists of a proposal for the solution of energy economy of the town. It first deals with further development of the centralised supply of heat for which several variants are considered. Then it concentrates on fossil fuels and renewable energy resources and economic assessment of all variants.

According to the town council's environmental officer,¹¹ the main reason for the development of the energy plan was the fact that many owners of newly privatised flats in apartment houses that were previously the property of the council, are unhappy about the prices of centrally supplied heat. They want to build their own heating units. During the 1990s the town made a large investment in gas-heating equipment. With growing prices of gas, people look for alternative ways of heating. There are also parts of the town which are never likely to be connected to gas pipes as its connection would represent excessive financial burden on the town council.

For these reasons the town council launched an initiative aimed at soliciting citizens' views concerning their preferred ways of heat supply. At the current early stage of this initiative's development, the town council sees supporting financially individual households that will decide for heating with biomass, ecological combustion of coal, heat pumps and wind power stations as a feasible option. With the exception of coal, households that decide for the renewable sources of energy could also apply for grants from the State Environment Fund.

In this particular case owners of apartment houses do not seem to be as reliable in the process of implementation of energy planning as mentioned earlier Karnik (2001). It is very probable that such cases also occur in other municipalities. When gas is brought to a municipality, the investor requires that majority of households have the connection made to the gas pipe. The most cost-effective option from the house owners' perspective is to have it done at the same time with the whole municipality. However, many house owners do not invest in gas boilers and cookers and carry on using other sources of energy that is cheaper. From the point of view of the local council it creates an uneconomical situation when owners of apartment houses disconnect from central supply. The energy plan of Policka investigated the option of combustion of biomass for central supply of heat. The town owns 2,065 hectares of forests. Most of other forests in the area are owned by the state. There is also a local producer of biomass from farming on 2,500 hectares. Using the estimation method used by Jiroudkova *et al.* (1997l)¹² according to which 10 hectares of healthy forest are needed to satisfy one household's needs of fuel wood in a sustainable way, it can be argued that the

¹¹ Coufal, J (J.Coufal@policka-mesto.cz) 25 September 2002 *Territorial Energy Plan of Policka*. E-mail to bohumira@volny.cz

¹² discribed in Chapter 4.

town's forests alone can provide wood fuel for 200 households (an equivalent of 2.2 per cent of the population).

The energy plan of Policka also recognises the potential of biomass for central supply heating units. It singles out suitable units for the future reconstruction. However, it does not see it as a current feasible option, at least not before the service life of the current equipment expires.

However, wood as an energy resource has already become a feasible option in Jindrichovice pod Smrkem. (population 620, Liberecky region). Heating with wood is a part of a territorial energy plan in this municipality that aspires to be energy self-sufficient. The local council in this peripheral village surrounded by forests employs 30 people who would be otherwise unemployed. Low salaries of these people are paid by the council and supplemented by state authorities to the level of the minimum income. These employees collect waste wood in the forests that are owned by this municipality. This wood heats the local government's office, a local school a hostel for the elderly and a local hostel. The local council also helps individuals who use waste wood to heat their homes by lending them a tractor with a trailer.¹³

Assessment of the potential of renewable energy resources is a part of territorial energy plans. If fuel wood is a part of them, it might be of significant importance for users of fuel wood in the future. Wood is a scattered and bulk resource that should not be transported for a long distance if it is to be used cost-effectively. In order to maintain their supply, larger consumers tend to make long term contracts with local suppliers of the fuel. With a growing interest in wood fuel, larger

consumers might easily use up all wood available in a given area leaving small consumers without access to fuel. According to the outcome from the EKIS questionnaire and my findings from i-EKIS, neither potential nor existing wood fuel users seek information about prospects of local availability of wood. On the other hand, the prospects for availability of fuel wood represented the most important problem for the respondents during my trial survey in 1996.

7.3.2. Part B of the SAR Programme Run by the State Environmental Fund

The main aim of the Programme is to support exploitation of renewable energy resources by non-profit organizations such as schools paid from the state budget, organisations, municipalities, citizens' associations, churches, non-profit organizations, associations of municipalities, legal entities founded by municipalities and enterprises. Individual citizens are also eligible to apply. The programme supports investment projects aimed at exploitation of renewable energy resources.

In their annual report the State Environmental Fund divides the projects into two groups. First group are large projects which are different from those appearing in part A under 1 A.b and 4 A.b. 1.A.b provide financial support for investment projects that exploit environmentally friendly ways of space heating and heating of water for flats and family houses. 4A.b. is a financial support available for investment projects that exploit heating with heat pumps for flats and family houses individuals.

Part 1.A.b offers financial support for investment projects that exploit environmentally friendly ways of space and water heating for flats and family

¹³ Personal communication with Petr Pavek, mayor of Jindrichovice pod Smrkem,

houses. Generation of heat from biomass is one of the environmentally friendly ways supported in this programme. Only owners of buildings that fulfil current legal insulation standards are eligible to apply. According to Vlč, ¹⁴ before an application is submitted to the State Environmental Fund, the applicant has to produce a professionally designed document that describes in detail how biomass is planned to be exploited. The building that is a subject to the project has to be assessed by an energy auditor. ¹⁵ He has to estimate whether the loss of heat of the building is within the legal limits. ¹⁶ If it exceeds the limits, insulation of the house has to be improved before the application can be processed. Then the application can be awarded only on the condition that the applicant proves that he invested at least 50 percent of the total investment cost. The conditions of the programs can be changed every year. The total sum for this programme in 2001 was approximately CZK 1 billion (Euro 31 million) in comparison with the CZK 700 million (Euro 22 million) the previous year. The state assistance increased by 30 per cent in comparison with 2000. Out of the 1 billion allocated for 2001, about 400 million (Euro 12.5 million) were used for implementation of the programme (Havlickova *et al.* 2001).

According to the report on their activities in 2001 provided by the State Environmental Fund (SEF 2002 b), there were 4 communal projects for biomass boilers subsidised in 1999. In 2000, 11 projects (3 private and 8 communal) were subsidised. A sharp growth in subsidised projects with biomass boilers took place in 2001 when 88 projects were subsidised (Table 7.2). In the same year 913 applications for all small projects were submitted and awarded and the total

(Prague), November 7, 2002.

¹⁴ Vlč, V (<http://www.i-ekis.cz>), 9 April 2002, *Fiencial support for biomass users*.

¹⁵ Edict on audits number 213/2001 Coll. from 14 June 2001.

¹⁶ CSN 730540, edict of the Ministry for Industry and Trade of CR, number 291/2001 Coll.

subsidy for them amounted to CZK 116,448,000 (Euro 3,639,000). Small projects are projects submitted by individual people applying for energy upgrading of their family houses. In the first half of 2001 for example, 34 applications were awarded for small projects for biomass boilers. (SEF 2002 a) The sum of money subsidising these projects was approximately CZK 2,280,000 (Euro 71,250). As a comparison, in the same period, there were 96 applications awarded for solar collectors with CZK 10,709,000 allocated (Euro 334,656) and 191 projects for heat pumps with CZK 21,724,000 allocated (Euro 678,875). Applicants can apply for financial support either directly to the SEF or, since January 2002, at 14 regional SEF offices.

As a result of implementation of the Programme, the total reduction of annual emissions of gaseous pollutants in the air should be 548 tonnes of SO₂, 493 tonnes of NO_x, 916 tonnes of CO, 191 tonnes of C_xH_y, 45 644 tonnes of CO₂) and 363 tonnes of particulates)¹⁷.

¹⁷ Novak L (lnovak@sfzp.cz) on 29 July 2002 *Eprinosy* E-mail to bohumira@volny.cz

TABLE 7.7: Projects realised by individuals:

Year 2001 (all small projects ^a)			January-June 2001 Small projects with biomass	
pollutant	gas (t/y)	Particles (t/y)	gas (t/y)	particles (t/y)
particulates		68.3		2.874
SO ₂	115.800		5.542	
NO _x	17.400		0.129	
CO	299.300		14.890	
C _x H _y	65.900		3.084	
CO ₂	10,023.000		530.100	
Total	10,522.100	68.3	553.745	
Total investment by SFE ^b in thousands CZK		116,448		2,280

^a(result of approximation of 321 cases then related to 913 applications)

^bState Fund for the Environment

There is a method¹⁸ used for assessing the reduction of greenhouse gases in energy projects. According to this method a reference level of emissions, so called 'a basic development curve of a project' means setting a basic development curve for a specific quantity (consumption of fuels, losses in the source, losses in pipes, final consumption of energy, financial investments and relating emissions of greenhouse gases) for the original technology and the new technical solution. It

¹⁸CEA: Metodika stanovení celkových redukcí emisí skleníkových plynů dosažených během doby životnosti realizovaných opatření [online]. Available from <http://www.ceacr.cz> [Accessed on 10 March 2003].

makes it possible to compare individual projects. The goal is to find benefits of realised projects. In most cases there is a set standardised method for each group of projects. Division into groups and application of the relevant method requires detail description of the project and its source is mostly an energy audit.

The IPCC method is used for inventorisation of CO₂ and other greenhouse gases. The method uses 'carbon emission factors'. It is the amount of carbon (CO₂) that falls to a unit of energy in a combusting fuel. Emission factors are listed in the IPCC method tables. Some financial support for non-investment and non-profit projects is also available in Part B in the sphere of non renewable energy resources, such as building public awareness and consultancy provided by the state administration and non-governmental organisations.

The number of projects supported by the SAR Programme is growing. However, its overall success is not assessed as unambiguously positive. According to Libor Ambrozek (2003), the current Minister of the Environment, the reality is different from what it was anticipated by the government when the programme was approved. At the beginning of its existence 1.5 per cent of consumption of primary energy sources at that time was regarded as the annual realistic increase of savings generated by renewables. It would require investments of about 6-8 billion Kc (Euro 187,500,000-250,000,000) which would represent about 2.5 billion Kc (Euro 78,125,000) allocated for the SAR Programme. The financial resources have never come up to 50 per cent of what it was promised. In the year 2000, for example the sum allocated to the Programme did not reach 25 percent of the anticipated financial incentives.

7.4. The Role of Non-governmental Organisations

Several non-governmental organisations operating in the Czech Republic promote biomass as a fuel as a part of their activities. The following examples illustrate the extent to which their activities facilitate the use of wood as a source of domestic heating.

EkoWATT is a non-governmental organisation that provides advice on efficient energy generation and practical use of renewable energy resources in the Czech Republic. They also carry out energy audits that help consumers choose the optimal sources of domestic energy in their specific conditions and indicate areas where reductions of energy consumption could be achieved. However, these audits tend to be expensive. On average, such an audit costs several thousands Czech crowns which can be more than the annual cost of wood fuel for one household. Therefore it is usually only private businesses which have their heating systems audited as they can include such services in their investment costs.

Another organisation active in the area of energy efficiency is SEVEN. The firm seeks to overcome barriers to the utilisation of the cost-effective potential of practical energy savings in the residential, industrial, and commercial sectors. When advising clients on energy efficiency options, SEVEN combines its technical expertise with economic analysis, an overall assessment including the projected environmental impact, proposals for the optimal method of financing, and the preparation of business plans for actual projects. Their projects also tend to be large-scale. They often prepare studies for the efficient use of energy for towns and cities. In 1997-1998 SEVEN drafted an area energy plan for the Sumava Regional Association of Municipalities. This project was financed by the

inhabitants. The main purpose of the project was to find out what forms of energy are available for practical use in individual municipalities and at what costs. Wood was one of the sources of energy that were recommended. As an outcome of the project all municipalities received their own document that included an analysis of the present state and a development scenario for energy consumption and emissions broken down by the type of fuel and sector. There was also information on co-financing options, basic overview and economic comparison of other options of a fuel.

7.5 Summary

The Energy Policy, an official document that formulates goals of energy management in the Czech Republic was passed by the government in 2000 and is to be reassessed at a minimum of two-year interval. Among the range of renewable energy resources referred to in the document (solar, wind, hydro-power and heat pumps and biomass), it is the latter which is ascribed a central role. According to the document, renewable energies should cover 4-8 per cent of total consumption of primary energy resources by 2020. Since the mid-1990s the Czech government has been developing support schemes to promote generation of renewable energy also among individuals as a part of a programme focused on promotion of efficiency in generation of energy. This policy is now being implemented by the Ministry of Industry and Trade and the Ministry of Environment. The Ministry of Industry and Trade used to have a programme aimed at promotion of renewable technology at the level of individual households. During the existence of the scheme it became apparent that the introduction of non-returnable grants introduced in 1996 caused a substantial increase in interest in projects on renewable energy resources. However, this scheme is no longer available for individual households. The Czech Energy

Agency (CEA) under the Ministry of Industry and Trade currently supports renewable energy at the level of individual households only by providing financial resources for the network of regional EKIS information centres and i-ekis on the Internet.

CEA is also involved in two other schemes relevant to the use of renewables including biomass. First, it offers grants to the private sector and non-governmental organisations which wish to develop educational programmes that promote renewable energies. Second, it supports the development of territorial energy planning by local authorities. These plans should balance the local use of energy in such a way that the meeting the needs of the local economy and of social development takes into consideration environmental protection and economical use of natural sources of energy. However, as was shown in the example of the town of Policka, the recent decisions concerning the development of local energy systems that oblige local governments to long-term loan-repayment compromise their ability to fulfil the obligations arising related to the development of territorial energy plans.

Subsidies for renewable energy projects aimed at individual citizens are provided by the State Environmental Fund, that operates under the Ministry of Environment. The conditions under which the available funds are allocated can be changed every year. This programme currently supports generation of heat from biomass. However, only owners of buildings that fulfil the legal insulation standards are eligible to apply for the subsidy. The application has to include a project developed by an expert and subsequently has to be assessed by an energy auditor. The number of projects receiving financial incentives from the SAR Programme has been steadily growing. Nevertheless, the overall amount of

financial incentives allocated by the government to the SAR Programme has never reached 50 percent of the amount anticipated at the time it was approved by the Czech government (Ambrozek 2003).

In order to find out what information people interested in using wood as a domestic fuel seek, a questionnaire was sent to all EKIS centres. It became clear that the prospective wood burners mostly seek information on technical parameters of appliances. The second most frequently asked questions relate to the subsidies for boilers that are available to their individual users, on procurement of the fuel and on local availability of wood.

In addition, such information is also provided by a number of non-governmental organisations. They offer advice, carry out energy audits, and prepare studies for the efficient use of energy for towns and cities including assessments of the potential of the biomass resources.

7.6 Conclusion

As a consequence of implementation of EU renewable energy policy, substantial changes have taken place during the pre-accession period of Czech Republic's harmonisation with the European Union in the area of using biomass as an energy resource in the Czech Republic.

Since the late 1990s the government's policy addressing the issue of wood fuel has become more focused. There are financial support schemes applicable for natural persons who want to heat their houses with wood. The government has also sought to create a free information network. Information on technology, support schemes, economy issue concerning wood as a fuel are both provided and

support schemes, economy issue concerning wood as a fuel are both provided and sought by consumers through this network. The network is used by the users of wood fuel.

General figures exist on the amount of exploitable wood in regions and district.¹⁹ Although they are being planned, so far there have not been available territorial plans of renewable energy resources on a large scale that would indicate how much of the fuel wood source is used and available. Nevertheless, a detailed overview for 2002 of the energy production from renewable energy resources²⁰ should be available for the first time ever.

We can sum up the factors that are important when people use wood to heat their houses in the Czech Republic: There is technology whose development and marketing is covered by private sector. Then the government has some policy that is aimed at individuals. The government, together with NGOs and private advisory firms provide information on heating with wood. The information provided is mostly on suitable technology, availability of technology and government's subsidies. This is also the information most often sought by the general public interested in heating with wood. A much smaller demand is for information on procurement of wood or its local availability. This attitude does not agree with the outcome of my survey among the people who already use wood as an energy resource because they found the procurement of wood as the most problematic part and the prospects of local availability of wood almost as a mystery. Territorial planning may represent a significant change in management

¹⁹ Forest Management Institute [online], Available from <http://www.uhul.cz> [Accessed on 12 June 2002].

²⁰ Edict 131/02 from 1.11.2001 passed by the Czech Statistical Office for the Ministry for Industry and Trade.

of wood as a fuel. Wood is a scattered resource of energy and so are the people who use it to heat their houses. Local councils should play a more significant role when energy plans become a part of territorial plans should become reality. Local councils, for example, could make efforts to bring together scattered partners such as suppliers of technology, sawmills and households in order to motivate and inform local people or potential consumers. In cases when local councils decide to support the use of biomass among public, their obligation should be to make sure that consumers have access to information in order to choose right equipment but also information about procurement and handling the fuel. The problems, identified in the pilot survey, surrounding procurement of biomass as an energy resource have not been tackled by the government policies. Therefore municipalities with a help of state funds should try solving the problem themselves.

If heating with wood is to be sustainable, the whole process from procurement of fuel to combustion should be a part of management, which is an integral part of communal management in the European Union. The principles of energy management as a part of energy policy should shift from the top down to the bottom up perspective comprising local authorities, energy agencies and individual consumers. There are still opportunities for different levels of the government.

CHAPTER 8: DISCUSSION

8.1 Introduction

This thesis set out to examine the potential of wood as a significant household renewable energy resource that could improve the quality of the environment in the Czech Republic, particularly in The Black Triangle, the most environmentally damaged region in the country. To that end I first needed to establish whether two 'technical' conditions making the use of wood possible were met. The first condition was the sufficient availability of sustainably obtained fuel wood in the Czech Republic. This question was addressed in Chapter 4. The second question was availability of a suitable technology for efficient and environmentally friendly combustion of wood. This was a topic of Chapter 5.

Once these two basic requirements were found to be fulfilled my research strategy followed two intertwined goals. First, the dissertation aimed to identify factors and influences that play a significant role in the process in which individuals make their decision about the use of wood as a renewable fuel. In the early 1990s, there were strong reasons to anticipate that people in the Black Triangle who decided to switch to wood as an energy resource were led primarily by their environmental beliefs. However, this hypothesis was not confirmed by the outcome of the pilot study (Chapter 6). Chapter 7 provides evidence that the renewability of wood as an energy resource is not foremost among the factors that attract people to use it as a household fuel. Reasons other than environmental issues appear to have been more important for those who actually decided to switch to wood as a fuel. These findings are discussed in section 8.4 of this chapter.

Second, this research sought to establish the extent to which the Czech government's policies aimed at promoting the shift to wood as renewable energy source succeed in assisting individuals to make this conversion. The underlying idea of this part of my research was that the identification of policy failures would enable me to suggest and formulate possible remedial measures. The effectiveness of the Czech government's renewable energy policies is discussed in section 8.5. The final part of this chapter (section 8.6) links the outcomes of the analysis of government policies with findings arising from individuals' experience of the use of wood.

8.2 Availability of Wood

As far as the extent of the forest cover is concerned, the situation in the Czech Republic has been relatively stable for centuries. The production of wood has also been stable. Changes in the ownership of Czech forests in the post-communist period do not seem to have significantly altered this long-term stability. There is a growing extent of unauthorised felling but that only represents about one per cent of the current annual production of 10 million cubic metres of felling. Estimation of waste wood available as a fuel has established that there is enough wood to satisfy the needs of approximately 260,000 households in the Czech Republic. That represents about 6 per cent of the total of 4,200,000 households in the Czech Republic. In case of the Black Triangle, 7.5 per cent of inhabitants could potentially use sustainably obtained wood as a renewable energy resource.

Fuel

One important outcome of my pilot survey was that people using wood as a fuel repeatedly reported their dissatisfaction with its quality and availability. When purchased, pieces of fuel logs were too large and needed to be adjusted to fit the appliances. People who ordered fuel from saw mills could neither order a particular quality nor know whether the wood delivered to them would be fresh or dry. However, issues such as these may have a crucial importance for the use of wood as an environmentally friendly fuel. These problems can be described as complications that are a consequence of the fact that the production of and trading of biofuels such as logs, chips, saw dust and straw are not regulated by norms (Sladky 2002). To effectively address these issues is important because these fuels represent the bulk of biomass fuels on the Czech market. There are preliminary norms for wooden briquettes but ninety per cent of the Czech briquettes production is exported (Sladky 2002). The importance of development of standards regarding renewable energy technology and the fuels used by this technology is also stressed by Danielsen *et al.* (2001).

The methods of procurement of fuel wood came out of the survey as a nuisance for people who use wood as a domestic fuel. Its relative abundance, but at the same time its scattered availability, and a labour intensive way of obtaining it, are all characteristics of wood as a fuel. Wood is used as a domestic fuel mostly in rural areas. The fuel may be found in a relatively close vicinity to potential consumers. These two facts make a case for the development of alternative procurement methods other than simply buying fuel wood from the closest supplier.

One example of an 'alternative' wood procurement system is used in Jindrichovice pod Smrkem, mentioned in Chapter 7. The local council in Jindrichovice employs people to collect wood that is then used to heat local buildings. The local council also helps individuals who use waste wood to heat their homes by lending them a tractor with a trailer. Although this example addresses some of the problems, it does not solve the problem in general. Simanov (1995) assumes that people interested in this way of household heating will be either owners of forests, people employed in forestry or people living in rural forested areas. Procurement of fuel wood in the form of self-production may be perceived as an active and useful way of spending their free time. A similar opinion is expressed by Tuttle (1980) when he states that 'unlike other fuels, the proximity and physical nature of wood fuel lends itself to consumer participation in the various stages of obtaining and preparing it'. His thesis analyses alternative procurement methods for fuel wood consumer groups in Ulster County in Maine, USA. This survey found out that 'a high proportion of wood burners supplied themselves with all or some of their wood, while 14 percent of all wood burners purchased wood as their primary resource'. The study identified 30 different consumer groups. The basic reasons for taking group action were similar in all cases:

- to provide financial benefits to the members;
- to provide a service to members that does not currently exist or is unsatisfactory;
- to combine resources: financial, labour, equipment;

Although the term 'a fuel wood consumer group' was at the time of my pilot survey unknown in the Czech Republic, the basic reasons for creating such groups were identical. People generally use fuel wood to cut down on heating costs. 'In addition to financial benefits, by working with others the individual wood burner's attitudes toward self-reliance are strengthened. That is to say, by working with others who, for

the most part, have similar values and reasons for burning wood, the individual's own self-image is strengthened'(Tuttle 1980).

In the Czech conditions such an attitude sounds almost impossibly idealistic. Respondents mostly thought that there was a very limited amount of fuel wood currently available and that the future would be very uncertain. Therefore it was necessary to keep their source of wood almost as a secret. According to Tuttle (1980), another serious reason for creating a consumer group was the unsatisfactory market system. The Czech consumers complained about unsatisfactory services provided by companies trading in fuel wood. Wood was not always available, companies either did not provide transport or it was expensive and they complained about the quality of wood. Tuttle (1980) also held that due to the unsatisfactory market systems that exist in many areas and the nature of wood as a fuel, wood users desire a greater control over the quality and volume that they obtain. It is a further reason for forming a consumer group.

Forming a consumer group also enables its members to combine resources to undertake actions that would be difficult to carry out individually (Tuttle 1980). In many cases, fuel wood consumer groups have been formed in order to procure wood more effectively. Also as a group, information about potential sources of stumpage or yarded logs is more easily communicated among interested members. Likewise, the group's interest in obtaining fuel wood in large volumes or during off-season can be expressed more directly to potential suppliers than when undertaken by a number of individuals separately.

Nearly two-fifths of the wood burners surveyed by Tuttle (1980) expressed an interest in participating in a co-operative fuel wood organisation. Ninety percent of them have indicated willingness to work for their fuel wood. One of the reasons for such a decision might have been awareness of certain limitations that could be overcome by participation in a consumer group. A membership in a consumer group could also enable them to reduce their expenses. Tuttle (1980) found out '... the response to the basic idea of a fuel wood consumer group is a clear sign that many wood burners are looking for alternatives to the present means of procuring and processing fuel wood'.

It is not surprising that people who can afford it prefer more comfortable heating to the labour intensive system. In Austria, for example, the use of wooden pellets has recently increased considerably. The market for pellet boilers doubled each year in the last five years (E.V.A. 2003), while the overall interest in heating with wood in Austria is declining. However, fuel wood is cheaper than pellets and price of the fuel is one of the most important factors when people decide to use it. This may be an opportunity for local governments to assume a more pro-active role. They could provide people with the know-how for creating consumer groups, provide space and help with organisation and communication between consumers and saw mills for example. This applies particularly to the local authorities that support increasing use of waste wood for generating heat. One of the successful cases of introduction of renewable energy in Austria analysed by Danielsen *et al.* (2001) was a case study looking at biomass district heating in Austria. They reported that it was typical that the successful cases were a result of the combination of 'bottom up initiative and top down support'. By support they meant creation of economic incentives and the

establishment of 'technology support system'. The two key elements of technology support were:

- logistic infrastructure providing fuels (in the case of biomass) efficiently and in the required quality;
- qualification of actors indirectly confronted with the new technology and the fuels: e.g. architects, land use planners, public decision makers etc; (Danielsen *et al.* 2001).

The same authors also came to the same conclusion that providing resources for establishing missing links in the technology support system in addition to financial incentives is the key to effective policies supporting renewable energy technology (Danielsen *et al.* 2001).

8.3 Technology

Altogether more than 30,000 efficient boilers burning wood were sold in the Czech Republic before 2002. There is a growing interest in this technology that is advertised and promoted as a progressive, efficient and environmentally friendly technology. The design of the appliance is vital if the requirements for both efficiency and environmental friendliness are to be fulfilled. However, it was also argued in Chapter 5 that these two characteristics are also seriously influenced by the way the appliance is used in reality. The nature of the fuel used and its water content are especially important. Failure to take account of these two factors may be the possible cause of pollution despite the use of a theoretically environmentally friendly energy source. There are indications such as expressed by Koutsky *et al.* (2002) that despite the technologists' best efforts there might still be a problem with the environmental performance of the appliances.

8.4 The Influence of Environmental Beliefs on Decisions about the Use of Wood as an Energy Source

The results of the pilot survey suggest that when people make a decision about switching to wood fuel, environmental awareness does not play a decisive role, although the underlying beliefs in the decision making process might have been environmentally oriented.

Individuals making decisions about switching to using wood as an environmentally friendly fuel often did it with the intention to perform an environmentally friendly decision. It is in an agreement with the adapted Fishbein's model as it is described in Chapter 6, part 6.2. However, environmental awareness appears to have been only one of three factors that influenced their decisions. The other two factors were a low price of the fuel and an opportunity to receive a subsidy. The subsequent stage of my research addressing the issue of the availability of information sources on wood as an energy resource revealed these two latter factors as more important than environmental awareness. The types of information most sought by people interested in heating systems based on wood concern suitable technology, its availability and access to government subsidies. To a smaller extent the public also demands information on procurement of wood and its local availability. The government, together with NGOs active in the field of renewable energy and private consultancy firms, all provide the public with information on efficient and environmentally friendly heating systems using wood as a fuel.

Zavestoski (2001) explains the relation between people's conception of themselves and their concern for the environment. It can help to understand why people's

concerns for the environment that may be present when they form their attitude towards an environmental technology such as efficient and environmentally friendly wood-based heating systems is not a salient factor in the decision-making. Zavestoski (2001) describes people's conception of themselves or the self-concept as the product of a process of reflecting on ourselves. It is an activity in which we adopt perspectives of other people in order to control how we must appear to other social actors. Based on this definition the self-concept can be said to be composed of various attitudes, ideas and beliefs we form about ourselves – or in short - our identities.

Zavestoski regards the self-concept as the root of individuals' values, attitudes and attributions of moral responsibility. He believes that it plays a crucial role in understanding consumption and environmental behaviours. He argues that identities comprise the self-concept and carry with them implications for action. As far as the relation between environmental concern and self-concept is concerned, Zavestoski (2001) points out that 'one significant function of the self in relation to attitudes and values is to provide an index of all possible outcomes of different attitude-behaviour combinations'. While it may be values that provide standards or goals that serve to guide action (Howard 1995; Rokeach 1973; Schwarz 1994 in Zavestoski 2001), it is the self-concept that contains the values used to compare the desirability of the outcomes of our possible courses of action. If an individual holds values specific to the quality of the natural environment, they should theoretically oblige him/her to consider and compare environmental impacts of possible courses of action. However, Inglehart ((1990) in Zavestoski (2001)), for example, argues that although many people have attitudes about environmental quality and value 'a clean environment' or

'a beautiful countryside', only very few individuals have highly developed values specifically related to the quality of the environment.

Stern and Dietz (1994), for instance, did not identify a separate biospheric-value orientation distinct from social-altruistic orientation. Even if such values existed, very few individuals developed awareness of the possible environmental outcomes of their behavioural decisions. Weigert (1997) notes that our experience with the natural environment is often influenced by social, cultural and social-structural obstacles. Therefore we feel detached from the environmental outcomes of actions we take. A possibility of an ecological self, in terms of sense of self that incorporates the natural environment so that self-preserving behaviour is also 'environment-preserving' behaviour was, according to Zavestoski (2001) researched by many. Weigert (1997), for instance, points out that people normally do not get direct, immediate and interpretable feedback from the environment.

My respondents from the Black Triangle region were once exposed to a severely damaged environment. It seems that they perhaps noticed the connection between their actions and their impact on the environment, but their concern for the environment did not become a part of their identity to the extent that it would decisively guide their behaviour towards the environment. Also, if they were individuals with an 'ecological self', then, according to Zavestoski, their environment preserving behaviour could also be a part of their self-preserving behaviour. Self-preserving might have been a very important factor in their decision making process (being able to use the cheapest fuel, saving money by obtaining subsidies, comfort). Leisure time activities of my respondents were very self-oriented (productive gardening, knitting, reading books). However, the participants of the survey were not

environmental activists with an ecological identity. They did not show signs of altruism that, according to Zavestoski (2001), might be a more important factor in understanding the relationship between the self-concept and environmental concern. He points out that 'the more compassionate individuals perceive themselves to be, the greater the chance that their compassion extends to the environment'.

8.5 Implications for Policy Change

The original consideration of this study was to establish why people decided to use a modern, efficient and environmentally friendly biomass technology and whether the possible beliefs and attitudes underlying the people's decision to switch to an environmentally friendly technology were environmentally oriented. This discussion can be extended further to a related debate about promoting sustainable life style through the government policies.

8.5.1 Change in Life Style

Switching from fossil fuels to wood as a renewable energy resource to a certain degree incorporates a change in behaviour and a change in life style that can be more environmentally friendly. The Czech case showed how a mixture of values, including people's concern for the environment, combined with EU-imported policies implemented by the government encourage the use of wood as an efficient and sustainable source of energy (which, in fact was an implementation of a sustainable life style).

In Britain, for example, sustainable life styles have been promoted through campaigns such as 'Action at Home' administered by the charity Global Action Plan

UK. 'Action at Home' is a voluntary programme that encourages changes in individual's household consumption practices by providing them with information, support and feedback. Hobson (2001) analyses the outcomes of her empirical research on Action at Home within discussions in the social sciences about public meanings and understandings of the concepts and communications of sustainable development. Another example of the attempt to promote sustainable life-styles was the campaign 'Are you doing your bit' launched by the Labour government in 1999. This programme aimed to encourage individuals to take ownership of their impact on the environment by providing tips for effective action that would also potentially help save on domestic bills (DETR 1999 in Hobson 2001).

The process in which people decide to switch from using a fuel polluting the environment to a renewable energy resource and environmentally sound technology was not promoted by a similar campaign in the Czech Republic. Instead, the developments in this field in the Czech Republic can be described as a process in which people directed their action in this particular area towards a more sustainable life style, which was, to the great extent, induced by the government policy. However, this government policy aimed at individuals consisted mainly of providing subsidies and of dissemination of practical information about a suitable technology (Chapter 5). Nevertheless, some lessons relevant to the Czech situation can still be learned be from the analysis carried out by Hobson (2001).

In the case of the pilot study described in Chapter 6, the environmental awareness of my respondents consisted mainly of their physical experience of living in a severely damaged environment (comprising their belief that a more environmentally friendly

fuel would improve the state of the environment, see Chapter 6, Figure 6.2). Their awareness was supported by the experience of public protests against these circumstances (society wants a change and therefore approves of performing the behaviour, see Chapter 6, Figure 6.2). Analysing the processes that take place when individuals engage with environmental communications, Hobson (2001) examines the relationship between environmental communications, lifestyles and practices. She draws on opinions that 'the success of implementing sustainable development is believed to be contingent upon the existence of an "informed and accepting public"' (Macnaghten and Jacobs 1997). It is furthermore argued that 'the "environment" has some intrinsic resonance with individuals (Lanthier and Olivier 1999), which can be appealed to, and which is a cause of widespread public concern'. Harrison *et al.* (1996) for example also contend that a major obstacle to public change toward a more sustainable life style is a lack of specific information.

According to Hobson (2001) 'it is assumed that once this information has been disseminated and read by individuals, behavioural change will follow'. Such a direct link between information and behaviour is founded upon positivist linear models of behavioural change which are based on rational, cognitive decision-making processes (Argyle 1992; Billig 1987; Shotter 1993 in Hobson 2001). Hobson (2001) finds the use of Ajzen and Fishbein's theory of reasoned action to predict behavioural change as being proved useful in the academic world. However, as far as policy is concerned, their main input has been to form a set of prevailing assumptions about the affective nature of information and the process of human-behavioural change, remarks Hobson (2001). The outcomes of the interviews conducted as a part of her research on 'Action at Home' programme, Hobson found out that the 'global environmental

issues (highlighted in the packs given to the participants) were not meaningful to a great number of interviewees'. As for the natural environment, the respondents linked it with their social environment and its social problems. How individuals' preferred patterns of action and choices had become established and executed, were contingent upon many factors, such as time, space, circumstances, money, personal preferences, values and goals. One part of the programme Action at Home suggested that participating in the programme was helping the environment and also saving money on domestic bills. For several interviewees financial savings represented one of the main reasons for participation. Other authors also supported the view that saving money plays an important factor in domestic behavioural patterns (Brandon and Lewis 1999).

The outcomes of my pilot survey corresponded with the findings of Hobson's research. The Czech government succeeded in promoting the use of wood as a renewable resource not by attempting to appeal to environmental awareness to the users of the new technology but simply by savings on their heating bills. The majority of participants in my pilot survey had the experience and knowledge that polluting the environment was bad, burning low quality coal was bad for the environment and burning wood in their modern boilers was less harmful to the environment. However, they had little knowledge about and interest in global environmental problems. Neither did they link their local environmental problems with the global environmental problems. Their social environment and problems with which they were confronted such as unemployment and insufficient public transport, were among their major concerns. By comparison the environment was a secondary problem. When they decided to use the new, wood-burning boiler, a shorter time spent on

managing the boiler affected their choice as well as some other circumstances (they needed a replacement for their old boiler anyway and often lived near a forest), especially financial incentives in the form of a subsidy. Most mentioned the subsidy when they were asked about what should be done to promote the use of the technology. Among other reasons mentioned were personal preferences (burning wood smells nice) and goals (the independence from public energy supply).

It appears that at one point in their lives, environmental concern of the people in my pilot worked as a factor influencing them when making a decision about using the new technology. However, it seems that its importance became steadily superseded by other factors. It was apparent from the way they used the technology. Despite the fact that they used an environmentally friendly technology, they did not seem bothered when their use of inappropriate fuel resulted in environmental pollution. Those respondents who found it difficult to build up a stock of wood in advance chose more convenient fuel alternatives, such as 'anything that would burn'.¹

8.5.2 The Achievements of the Government in Promoting Wood as Renewable Energy Resource

As far as the government role is concerned, apart from disseminating information via the system of consultancy centres (EKIS) on appropriate technology - its availability and practical use - the Czech government provides subsidies to individuals who decide to buy particular wood burning appliances. Subsidies seemed the most

¹ Misuse of the same technology was also found elsewhere in the Czech Republic; a personal communication with Jiri Zeman, deputy manager of SEVEN, Prague, November 15, 2002, for instance in the Sumava Region as described in the *Study Region Sumava* carried out by Centre for Effective Use of Energy, Prague (1999).

important incentives for the interviewees in the pilot survey. They were also repeatedly reported as decisive by EKIS centres:

'The number of individual inquirers is growing because of the government's subsidies ' (EAV Jihlava; for more detail see Chapter 7, Questionnaire for EKIS centres)

and

'The number of individual questioners is growing but not because of environmental awakening. An increase occurred in the second quarter of 2002. It was caused by a massive advertising of the subsidies programme which was launched by Atmos (a boiler- producing company)'. (JSM Hradec Kralove; for more detail see Chapter 7, Questionnaire for EKIS centres)

The information on the correct use of the technology including the required characteristics of fuel (the quality, type and moisture content of fuel and suitable output of an appliance) is accessible to consumers in the Czech Republic. Consumers have an opportunity to obtain such information when purchasing the appliance from the supplier or from EKIS, i-EKIS and several non-governmental organizations. However, the experience shows that the mere availability of such information does not guarantee that the the maintenance of purchased technology advertised and subsidised as efficient and environmentally friendly, is actually used as such in such a way in real-life circumstances.

In an ideal situation, there should be means that would effectively communicate the need to maintain and use this technology in an appropriate way to individual users. Hobson (2001) suggests that there is a serious problem with the current policy of implementing sustainable life styles based on environmental communications and prevailing positivist strategies. She argues that, rather than 'placing the emphasis on individuals learning about global issues, there needs to be an engagement with issues that have a meaning in everyday lives to capture the energy of the rhetoric with the individual.'

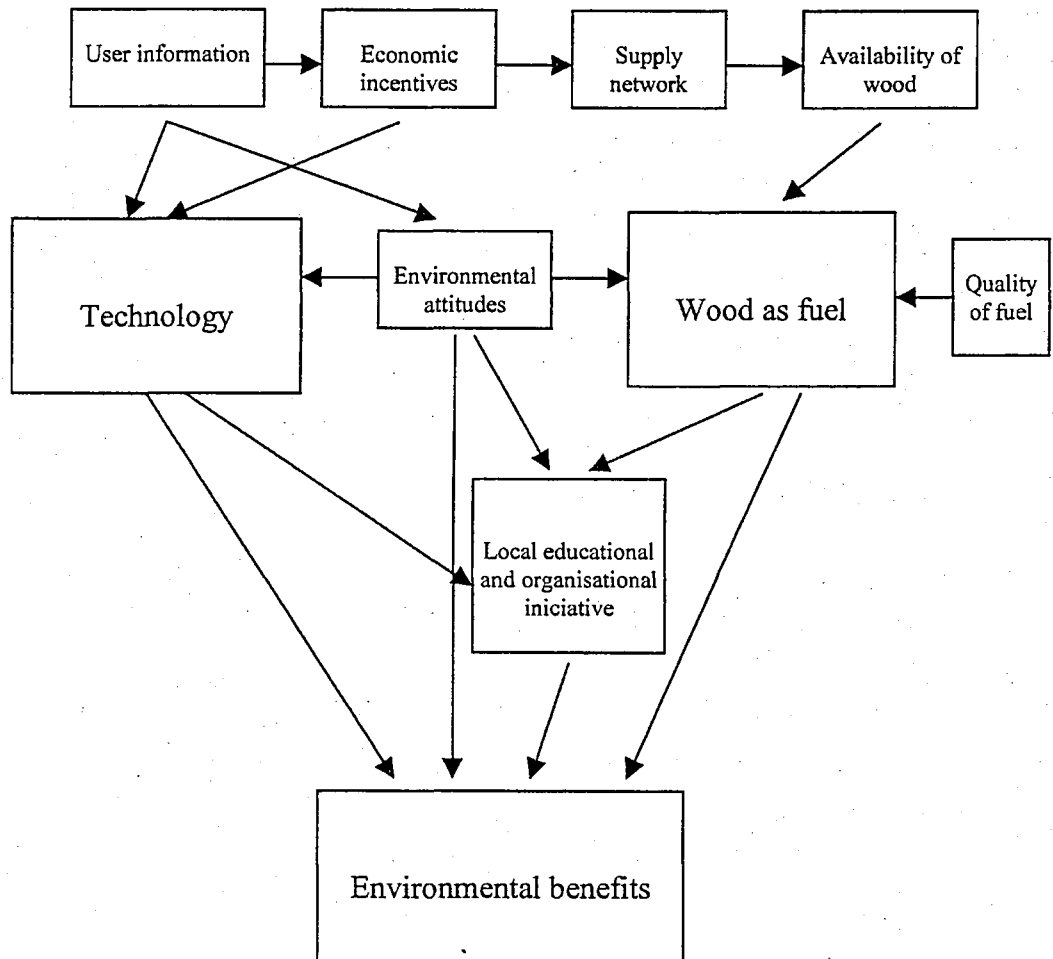
Austria, for instance, has a long-term experience of promoting wood as a renewable energy resource. Since the early 1990s 500,000 wood burning individual appliances were in use in this country, out of which 150,000 were modern, efficient and environmentally friendly technologies (Schmidl 2001). However it does not mean that the familiarity with this technology is embedded in society. Dell (1998) pointed out that despite Upper Austrian² energy policy goal based on reaching as many people as possible to make them aware of the opportunities offered by renewable energy resources, there is still a lack of awareness and know-how where and how to use such technology.

Findings from my research lend a strong support to the argument that in considering promotion strategy for environmentally friendly wood burning-based energy at the household level, we need to look beyond the immediate availability of environmentally friendly technology and of fuel. Several other factors play an important role in the process in which individuals make a decision about whether or

² Upper Austria is one of eight *lander* that make up Austrian federal state.

not to use wood as a fuel as well as access to information on the appropriate use of the technology and on availability of wood. My findings suggest that the information on economic incentives as well as the existence of incentives themselves are of crucial importance for people considering to switch to wood as a fuel. Environmental attitudes may also influence people's decisions about using wood as a fuel. However, they are likely to play even a more important role when wood burning appliances are in use. Providing households only with the above mentioned list of information does not seem sufficient if wood is to be used for heating purposes in an environmentally friendly way. Local educational and organisational initiatives may be an important factor to ensure both the availability of wood to its users and its use in a way beneficial to the environment (Figure 8.1).

Figure 8.1: Factors that can Affect the Use of Wood as a Domestic Fuel



8.6 Conclusion

Although general availability of wood and of suitable technology are crucial for a successful development of use of fuel wood as a renewable energy resource, other factors also play very important roles. The way in which the wood burning appliances are used by their owners and procurement of the fuel may ultimately determine whether this way of heating can actually be described as renewable energy generation. If the Czech government promotes modern environmentally friendly

wood burning technology but a considerable number of its users do not consider it necessary to use it in an effective way, it has to be concluded that this amounts to a partial policy failure. At the same time, however, this finding identifies one of the major opportunities for rectification of this policy. Thus it seems important to find the way to address those people who are using this sustainable energy technology at the local level. One possibility would be to engage with them in communication about the effective use of their boilers including some form of an ethical engagement about the benefits of renewable energy for a shift towards more sustainable life style, which in turn can benefit to the ecosystem. The 'top down support' as suggested by Danielsen *et al.* (2001) could provide resources for establishing missing links in the system. Apart from economic incentives there is also opportunity to establish a technology support system or logistic infrastructure that provides fuels efficiently and, particularly, of the required quality. Involvement of actors indirectly involved with the use of technology, such as public decision makers is also likely to be important. These links would supplement the 'bottom up local initiative' (Danielsen *et al.* 2001). These are inspiring ideas, based on experience and should be considered for implementation in the Czech circumstances.

Czech experience of the use renewable energy as presented in this thesis, could have wider implications for the transition to renewable energy. My research supports the opinion that the conventional approach to promoting renewable technology is necessary and can be successful. Dissemination of information to prospective users, the use of demonstration projects, addressing institutional and legal constraints, introducing new laws and regulations that favour renewable energy resources such as subsidies, suggested, for instance, by Everett (1996), are all means that contribute to

successful development of biomass energy. However, this thesis suggests that this conventional attitude should be supplemented by a highly individual approach at the local level, where the technology is used and fuel obtained. The opportunity here is especially for the local councils that can act as educational and organisational centres within small communities where the use of renewable technology is affected by individuals and their life style. When individuals are encouraged through incentives, to switch to using renewable and environmentally friendly energy generation then it should be maintained that the energy generated by these individuals is environmentally friendly in real life. Since any negative environmental impact of wood-based renewable energy is first of all a local problem, the local councils could get involved in educating people how to heat with wood and they could also act as centres providing organisational infrastructure for procurement of waste wood. Renewable energy users should be made aware of the fact that their switch to wood involves a change in their life style. This approach seems particularly important for maintaining environmental friendliness of wood-based generation of energy.

I conclude with several tentative recommendations for some of the major actors in the processes in which fuel wood is used as a renewable energy resource:

Local authorities should:

- consider carefully the local potential of sustainably obtained waste wood with regards to the local energy plan and demand for this fuel;
- get involved in establishing support system that provides fuel efficiently and in required quality;

- set up help for alternative methods of fuel procurement;
- spread information about the benefits of consumer groups which could provide the users of wood as a fuel better control over the volume and quality of fuel;
- provide help with organisation and communication between consumers and saw mills;
- engage in discussions with the users covering environmental issues that have a meaning in the everyday life of the users, in order to stress the local environmental benefits/threats of the use of wood for heating;

Users of wood as a domestic fuel should:

- consider carefully the source of their fuel before they make decisions about the purchase of technology;
- seek advice and help from the local authorities;
- organise with other users locally in consumer groups, for example;
- recognise that the use of the new technology whose management and maintenance requires environmentally friendly handling of the fuel, will require some life style changes, such as using fuel of a certain quality;

The government should:

- supplement the current promotion of the use of wood as a renewable energy resource based on saving domestic bills by attempting to appeal to environmental awareness of the users of the new technology;
- support more research into the aspects of environmental friendliness of the technology;
- prepare legislation enabling local authorities to perform functions outlined above.

Recommendations for further research

Given the importance of a careful consideration of the fuel it would be very useful to investigate how the parts of territorial energy plans that relate to local biomass resources are used by local authorities. It would be also helpful to investigate in detail more experiences with alternative procurement methods in the Czech Republic and abroad in order to give more precise advice to consumers.

REFERENCES

- Adamkova, A. (2003) 'Plyn od dubna zdrazi o osm procent', *Plzensky denik*, 25 February, p.3.
- Alakangas, E. (1998) 'Versatile dissemination of bioenergy information in Finland', in the proceedings of the 10th Conference and Exhibition "Biomass for Energy and Industry", Wurzburg, Germany 8-11 June 1998, pp. 1207-1210, C.A.R.M.E.N (Centrales Agrar-Rohstoff-Marketing und Entwicklungs-Netzwerk), Straubing, Germany.
- Alexander, G. (1996) *Overview – the context of renewable energy technologies* in Boyle G. (ed.) (1996), *Renewable energy*, Oxford, Oxford University Press, pp. 1- 40.
- Ambrozek, L. (2003) 'Vyuziva CR alternativni zdroje dostatecne?' *Literarni noviny*, 22 April, 2003, p. 16.
- Anderson, V. (1993) *Energy efficiency policies*, London, Routlage.
- Beranovsky, J., Jurica, J., Prchlik, L. and Truxa, J. (1995) *Ekonomicke hodnoceni obnovitelnych zdroju energie*, Praha, EkoWatt.
- Beukering, P. and Vellinga, P. (1996) 'Climate change: From science to global policies' in Sloep P. and Blowers A. (eds.), (1996), *Environmental policy in an international context*, London, Arnold, pp. 187-215.

Blackmore, C. and Furniss, P. (1997) *T860, Introduction to environmental decision making*, Milton Keynes, The Open University.

Blackmore, R. and Barratt, R. (2003) 'Dynamic atmosphere: changing climate and air quality' in Morris D. *et al. (eds.)*, (2003) *Changing Environments*, Chichester, John Wiley & Sons Ltd., pp. 231-275.

Blaha, J. (1996) 'V lesích jako na poli', *Poslední generace*, vol. 5, no. 2. p. 11.

Carno, J., Berg, M. and Jaras, S. (1996) 'Catalytic abatement of emissions from small-scale combustion of wood', *Fuel* [online] vol. 75 no. 8, pp. 959-965. Available from <http://www.sciencedirect.com/science/journal/00162361> [Accessed on 14 March 2003].

Chalmers, N. and Parker, P. (1986) *The OU project guide*, an Open University set book, Shrewsbury, Field Studies Council.

Chartier, C. P., de Silguy, C. S. C, Defaye, S. D. S. and Battais, L. B. L., (1998) 'Perspectives for biomass energy in the European Union – how a 200 per cent increase can be attained', in *Proceedings of the 10th Conference and Technology Exhibition Biomass for Energy and Industry*, 8-11 June, 1998, Wurzburg, Germany, pp. 1117-1120, C.A.R.M.E.N (Centrales Agrar-Rohstoff-Marketing und Entwicklungs-Netzwerk), Straubing, Germany.

Chovanec, D. (1992) 'Thermal degradation of wood' in *Proceedings of the Conference Wood Burning 92*, 10-15 May 1992, Zvolen, Slovakia, p. 241-247, Technicka univerzita Zvolen.

Commission of the European Communities (1997) *Energy for the future: Renewable Sources of Energy. White Paper for a Community Strategy and Action Plan*. Communication from the Commission COM (97) 599 final, Brussels.

Commission of the European Communities (2001) *Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions, on the sixth environment action programme of the European Community 'Environment 2010: Our future, Our choice'* presented by the Commission in Brussels, 24.1.2001.

Council of Europe (2001) *Structure and operation of local and regional democracy – Czech Republic*, Strasbourg, Council of Europe Publishing, 2nd edition.

Cowburn, D. A. (1998) 'The reduction of emissions from combustion of biomass for domestic heating applications', in *Proceedings of the 10th Conference and Technology Exhibition Biomass for Energy and Industry*, 8-11 June, 1998, Wurzburg, Germany, pp. 1117-1120, C.A.R.M.E.N (Centrales Agrar-Rohstoff-Marketing und Entwicklungs-Netzwerk), Straubing, Germany.

CSO (1998) *Spotřeba paliv a energie v domácnostech za rok 1996*, Český statistický úřad, Praha.

Danielsen, O., Hackstock, R., Koukios, E., Kunze, G., Rakos, C. and Sidiras, D. *What makes renewable energy work*, [online] Vienna, Energie Verwertungsagentur, Available from: <http://www.eva.ac-at./projecte/> [Accessed on 12 February 2003].

Dell, G. and Egger, C. (1998) 'Job Creation in SMES by regional programmes to boost wood-based individual heating systems', in *Proceedings of the 10th Conference and Technology Exhibition Biomass for Energy and Industry*, 8-11 June, 1998, Wurzburg, Germany, pp. 73-76, C.A.R.M.E.N (Centrales Agrar-Rohstoff-Marketing und Entwicklungs-Netzwerk), Straubing, Germany.

Drbohlav, D. (1991) 'K problematice vztahu preference – migrace', *Zpravy GGU CSAV*, vol. 28, no. 3, pp. 29 – 38.

EkoWATT Energie Biomasy, [online], EkoWATT – Infolisty. Available from <http://www.ekowatt.cz/library/infolisty>. [Accessed on 6 June 2003].

E.V.A. (2003) *Renewable Energy - the Way Forward for the Next Century* [online], Energie Verwertungsagentur. Available from: <http://www.eva.ac-at./projecte/> [Accessed on 12 February 2003].

Everett, B. and Boyle, G. (1996) 'Integration' in Boyle G. (1996), *Renewable energy*, Oxford, Oxford University Press, pp. 394-434.

Fagin, A. and Jehlicka, P. (2002) 'Contours of the Czech Environmental Movement: a comparative analysis of Hnutí Duha (Rainbow Movement) and Jihočeské matky (South Bohemian Mothers)', *Environmental Politics*, vol. 12, no. 2 (forthcoming).

Fishbein, I. and Ajzen, M. (1975) *Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research*, London, Addison Wesley.

Fishbein, M. and Madden, T. J. (1986) 'Prediction of Goal-Directed Behaviour: Attitudes, Intentions, and Perceived Behavioural Control', *Journal of Experimental Psychology* vol. 22, pp. 453-474.

Folk, J. (1935) *O palivovém dríví a zvýšení jeho spotřeby k otopu*, Drevarský syndikát v RCS.

Forest Management Institute *Základní údaje podle kategorií a subkategorií lesa* [online], Forest Management Institute. Available from [http:// www.uhul.cz](http://www.uhul.cz). [Accessed on 12 June 2002].

Gille, Z. (1997) 'Two Pairs of Women's Boots for a Hectare of Land: Nature and the Construction of the Environmental Problem in State Socialism', *Capitalism, Nature, Socialism* vol. 8 no.4, pp.1-21.

Grubb, M. (1993) *The Earth Summit Agreements*, London, Royal Institute of International Affairs/Earthscan.

Grubb, M., Brack, D. and Vrolijk, C. (1999) *The Kyoto protocol: a guide and assessment*, London, Royal Institute of International Affairs/Earthscan.

Gustavsson, L. and Karlsson, A. (1998) 'Biomass energy systems for single family houses – efficiency, emissions and costs', published in the proceedings of the 10th Conference and Exhibition "Biomass for Energy and Industry", Wurzburg, Germany 8-11 June 1998, pp. 1409-1412, C.A.R.M.E.N (Centrales Agrar-Rohstoff-Marketing und Entwicklungs-Netzwerk), Straubing, Germany.

Harrison, C. M., Burgess, J. and Filius, P. (1996) 'Rationalizing environmental responsibilities - A comparison of lay publics in the UK and the Netherlands', *Global Environmental Change*, vol. 6, no. 3, pp. 215-234.

Hanousek, M. (2001) *Topime drevem*, Prague, Czech Republic, Grada Publishing s.r.o.

Havlickova, M. and Ruzickova, M. (2001) *State Programme of Support for Energy Saving and Use of Renewable Energy Sources*, Energy Economic Bulletin for the Czech Republic, Prague, SEVEN.

Hobson, K. (2001) 'Sustainable Lifestyles: in Rethinking Barriers and Behaviour Change' in Cohen M. J. and Murphy J. (eds.), (2001): *Exploring Sustainable Consumption: Environmental Policy and the Social Sciences*, Elsevier Science Ltd, Oxford UK, pp. 191-209.

Howard, J. (1995) 'Social cognition' in K. Cook, G. Fine and J. House (eds.), (1995): *Sociological Perspectives on Social Psychology*, Boston, Allyn and Bacon pp. 90-117.

Hutka, P., Sladky, V. *Vyznam lesni stepky pro energetiku* [online], TZB-info. Available from <http://www.tzb-info.cz/>. [Accessed 7 April 2002].

Hyytiainen, H. (1998) 'Newly Designed Domestic Stoves with low emissions and high efficiency', published in the proceedings of the 10th Conference and Exhibition "Biomass for Energy and Industry", Wurzburg, Germany 8-11 June 1998, pp. 1527-1528. C.A.R.M.E.N (Centrales Agrar-Rohstoff-Marketing und Entwicklungs-Netzwerk), Straubing, Germany.

Intergovernmental Panel on Climate (IPCC) (2001) *Climate Change 2001*, Synthesis Report. Third Annual Report of the IPCC Cambridge, UNEP/WHO. Cambridge University Press.

Jehlicka, P. and Kara, J. (1994) 'Ups and Downs of Czech Environmental Awareness and Policy: Identifying Trends and Influences', *Regional Politics and Policy*, vol. 4, no. 1 pp. 153-171.

Jiroudkova, M. and Brandt, D. (1997) 'Vyuziti biomasy v oblasti cerneho trojuhelniku', in *Proceedings of the Conference 'The Use of Biomass in Energy Production*, Opocno, Czech Republic, 3 September 1997, pp. 9-17.

Karnik, J. , (2001) 'Energy Policy of Czech Towns in comparison with EU countries', *Zpravodaj SEVEnu*, vol. 9, no. 1, p. 3.

Klvacova, P. (1997) *Zmena vlastnickych vztahu a zivotni prostredi*. Diploma work defended at the Faculty of Social Sciences, Charles University, Prague.

Kornai, J. (1980) *Economics of shortage*, Amsterdam: North-Holland.

Koutsky, M., Dittrich, M. and Vosta, J. (2002) 'Biomasa a zivotni prostredi - rizika tvorby dioxinu pri spalovani biomasy a mozne zpusoby její eliminace' in *Proceedings of the conference as a part of Energy Efficiency Bussiness Week*, November 5-7 2002, SEVEN- The Energy Efficiency Center Prague, Czech Republic.

Launhardt, T. (1998) 'Formation of dioxins and PAH in domestic wood furnaces – contamination of flue gas, ashes and chimney soot', published in the proceedings of *the 10th Conference and Exhibition "Biomass for Energy and Industry"*, Wurzburg, Germany 8-11 June 1998, pp. 249-252, C.A.R.M.E.N (Centrales Agrar-Rohstoff-Marketing und Entwicklungs-Netzwerk), Straubing, Germany.

Mikula, S. (1997) 'Podpora energetického vyuzivani biomasy v cinnosti MZE CR' in *Proceedings of the Conference 'The Use of Biomas in Energy Production*, Opocno, Czech Republic, 3 September 1997, pp. 1-8.

Ministry for Agriculture of the Czech Republic (1995) *Report on Forestry of the Czech Republic*, compiled by Institute for Forest Management, Brandys nad Labem

Ministry for Agriculture of the Czech Republic (1998) *Report on Forestry of the Czech Republic*, compiled by the Institute for Forest Management, Brandys nad Labem

Ministry for Agriculture of the Czech Republic (2001) *Report on Forestry of the Czech Republic*, compiled by the Institute for Forest Management, Brandys nad Labem.

Murphy, J. and Cohen, M. J. (2001) 'Consumption, Environment and Public Policy' in Murphy, J., and Cohen, M.J. (eds.), (2001) *Exploring Sustainable Consumption: Environmental Policy and the Social Sciences*. Elsevier Science Ltd, Oxford UK, pp. 3-17.

Nikolaisen, L. (ed.) (1992) *Straw for Energy Production*, Soeborg, Centre of Biomass Technology.

Oregon State University *Dry wood - Dry firewood means more heat and less pollution* [online], Oregon State University. Available from <http://www.eesc.orst.edu/agcomwebfile/news/home/dryfirewood.html>. [Accessed 23 March 2003].

Olivier, D., Elliott, D. and Reddish, A. (1991) 'Sustainable Energy Futures' in Blunden J. and Reddish, A. (eds.), (1991): *Energy Resources and Environment*, London, Hodder & Stoughton, pp. 180-232.

Pesat, J. and Ligočka, D. (1998) 'Utilization of biomass for heating in the Czech Republic', in *Proceedings of the 10th Conference and Technology Exhibition Biomass for Energy and Industry*, June 8-11, 1998, Würzburg, Germany, pp. 1117-1120, C.A.R.M.E.N (Centrales Agrar-Rohstoff-Marketing und Entwicklungs-Netzwerk), Straubing, Germany.

Poleno, Z. (1994) *Priručka pro majitele lesa*. Praha, Ministerstvo zemědělství ČR – odbor lesního hospodářství.

Pondelicková, A. *Strategy of pre-accession period in forestry of the Czech Republic* [online], Czech Ministry of Agriculture. Available from <http://www.mze.cz>, [Accessed on 10 July 2000].

Rakos, C. Lecture held at the meeting OPET Bothnia (Norrlund)/Opet Austria on 18th November 1998. Available from <http://www.eva.wsr.ac.at/english/biomass.htm/>. [Accessed on 21 August 1999].

Ramage, J. (1996) 'Biomass in Boyle G. (ed.) (1996): *Renewable energy*, Oxford, Oxford University Press, pp.137-182.

Reddish, A. (2003) 'Dynamic Earth: human impacts' in Morris D., Freeland J., Hinchliffe S. and Smith S. (eds.), (2003): *Changing Environments*, Chichester, John Wiley & Sons Ltd, pp. 49-96.

Roseland, M., Cureton, M. and Wornell, H. (1998) *Toward Sustainable Communities: Resources for Citizens and Their Governments*, Gabriola Island, New Society Publishers, pp. 24-25.

Schmidl, J. (2002) 'Zkušenosti s rozvojem a podporou energetického využívání biomasy v Rakousku' in *Proceedings of the Conference as a part of Energy Efficiency Business Week*, November 5-7 2002, SEVEN- The Energy Efficiency Center Prague, Czech Republic.

Selong, D. *Hodnocení státní podpory rozvoje obnovitelných zdrojů energie a kogenerace v rámci České energetické agentury Ministerstva průmyslu a obchodu ČR za léta 1991-1997 a předběžného zhodnocení roku 1998*, [online], BIOM Available from: <http://www.czbiom.ecn.cz/> [Accessed on 23 May 2002].

Simanov, V. (1993) *Dřevo jako energetická surovina*, Praha, Ministerstvo zemědělství ČR, Agropoj.

Simanov, V. *Palivo nebo organická hmota? Odlišné pohledy na využití odpadního dřeva z lesních tezeb* [online], LEA. Available from <http://www.lea.ecn.cz/> [Accessed on 11 November 2002].

State Environmental Fund (2002a) *Aktuality* [online], State Environmental Fund. Available from [http:// www.sfzp.cz.](http://www.sfzp.cz.) [Accessed on 10 May 2002].

State Environmental Fund (2002b): *Investice a ekologické přínosy akcí kladných rozhodnutí v roce 2001* [online], State Environmental Fund. Available from <http://www.sfzp.cz>. [Accessed on 20 September 2002].

Tellegen, E. (1996) *Environmental conflicts in transforming economies: Central and Eastern Europe* in Sloep, P. and Blowers, A (1996) *Environmental Policy in an International Context: Conflicts*, London, Arnold, pp 67-96.

The Czech Statistical Office *Ceske domacnosti ve svetle Scitani lidu, domu a bytu 2001* [online], The Czech Statistical Office. Available from <http://www.czso.cz/csu/csu.nsf/informace/TISLDB>. [Accessed on 16 April 2003].

The UK Department of Trade and Industry *UK Energy in Brief* [online], DTI. Available from <http://www.dti.gov.uk>. [Accessed on 25 May 2003].

Ustav hospodarske obnovy lesa *Zprava o stavu lesa za rok 2001* [online], Ustav hospodarske obnovy lesa. Available from <http://www.uhul.cz/zz2001>. [Accessed on January 3 2003].

Vanek, M. (1996) *Nedalo se tady dychat*, Praha, Ustav pro soudobé dějiny AV ČR, Maxdorf.

Vikkelso, A. and Andersen, A. N. (1993) *Co je to spolek pro energii a životní prostředí, Energie-kde ji vzít*, translated by EcoWATT, Prague, pp. 7-11.

Wohlgemuth, N. (1998) 'The role of renewable energy technologies in a systems approach: an effective promotion strategy under multiple objective considerations', in *Proceedings of the 10th Conference and Technology Exhibition Biomass for Energy and Industry*, June 8-11, 1998, Wurzburg, Germany, pp. 1117-1120, C.A.R.M.E.N (Centrales Agrar-Rohstoff-Marketing und Entwicklungs-Netzwerk), Straubing, Germany.

World Commission on Environment and Development (1987) *Our Common Future*, Oxford, Oxford University Press.

World Health Organisation *Dioxins and Their Effects on Human Health*, Fact Sheet No. 225 [online], WHO. Available from <http://www.who.int/info/fs/en/fact225.html>. [Accessed on 27 May 2003].

Zavestoski, S. (2001) 'Environmental Concern and Anti-consumerism in the Self Concept: - do they share the same basis?' in Cohen, M. J. and Murphy, J. (eds.), (2001) *Exploring Sustainable Consumption, Sustainable Lifestyles: Rethinking Barriers and Behaviour Change*. Elsevier Science Ltd, Oxford UK, pp. 173-189.

Zeman, J. (2003) 'New law supporting electricity generation from renewable energy sources', *News at SEVEN*, vol. 11, no. 3, p. 1

APPENDIX I: NUTS

Within the European Union nomenclature of territorial statistical units (NUTS¹) is used for making various comparisons. They are essential for statistical purposes of EU. Statistical service of EU is covered by EUROSTAT based Luxembourg. In agreement with EUROSTAT, the units in the Czech Republic were decided as follows²:

NUTS I

It is one unit for the whole Czech Republic.

NUTS II

The average population in EU NUTS II unit is 1 830 000. Since most of the Czech regions (region = kraj) have a smaller population, one unit NUTS II usually comprises more than one Czech region.

The Czech Republic is divided in eight territorial units. Praha (only the territory of the capital), Stredni Cechy (only Stredocesky kraj), Jihozapad (Budejovicky kraj a Plzensky kraj), Severozapad (Karlovarsky kraj and Ustecky kraj), Severovychod (Liberecky kraj, Kralovehradecky kraj and Pardubicky kraj), Jihovychod (Brnensky and Jihlavsky kraj), Stredni Morava (Olomoucky and Zlinsky kraj) and Ostravsko (only Moravskoslezsky kraj)

¹ La nomenclature des units territoriales statistiques

² Agreement of the government of the Czech Republic number 707, from 26.10.1998, Uvod do regionalnich ved a verejne spravy, edice JUSTIS, Praha 2001, page 51 and 53.

NUTS III

In small EU countries NUTS III oscillates between 200 and 400 thousand inhabitants, the EU average is 410 000 inhabitants.

NUTS III in the Czech Republic represent 14 regions (region = kraj)

NUTS IV

NUTS IV is not delimited by number of inhabitants in many EU countries.

IN THE In the Czech Republic they are represented by 77 districts (district = okres).

NUTS V

In NUTS V are 6250 municipalities, almost 80 percent of them have fewer than 1000 inhabitants.

APPENDIX II

VERNER a.s.

Sokolská 321

549 41 Cervený Kostelec

tel. +420 491 465 024, fax +420 491 465 027

<http://www.verner.cz>

verner@verner.cz

DAKON s.r.o.

Ve Vrbine 588/3

794 01 Krnov-Pod Cvilínem

<http://www.dakon.cz>

e-mail: dakon@dakon.cz

HORAL

Bruntal

Polní 1

792 01 Bruntal

FERKA

Strojní zamecnictví

Lipová 650

407 21 Česká Kamenice

ATMOS JAROSLAV ČÁNKAR & SYN

Velenského 487,

294 21 Bělá pod Bezdězem

<http://www.atmos.cz>

APPENDIX III: PILOT SURVEY 1996

1. Questionnaire for consumers who use wood as a domestic fuel and burn it in for this purpose-designed boilers or stoves.

The aim of the questionnaire was to find out what reasons respondents had for using wood as a domestic fuel and what experiences they gained

2. Questionnaire for people who live in similar conditions (area) and use other domestic fuels than fuel wood.

Questionnaire 2 had the same design as questionnaire 1 except for several alterations in the Part 2 these alterations are in the Part 2.

Part 1

In this part of the questionnaire I asked about the appliance respondents used for burning wood in their house.

1. What type and size of the appliance do you have?
2. How did you learn of the boiler (stove)?
3. When did you buy it?
4. How much did you pay for it?
5. Did you have a similar appliance before?
6. How much time do you spend on managing the boiler (stove) every day during the heating season?
(adding fuel, cleaning appliance, removing ash, maintenance and repairs)
7. How much time do you spend on managing the boiler (stove) every day during the rest of the year?

(adding fuel, cleaning appliance, removing ash, maintenance and repairs)

8. Can you compare the time you spend now on managing your boiler (stove) it with the time you spend on managing your previous appliance?

9. Are you satisfied with your boiler (stove)?

If yes why?

If not why?

Answers of interviewees who used wood

Name	1.	2.	3.	4.	5.	6.	7.	8.	9.
Jezkova Brandov	P25	TV advert., from the forest manager	92	18000 /15000 donations	No	Cleaning 2x a season, Ash 1x a week, Loading 4x a day during big frosts (NEVER use at max output)	Ash: 1x month	Burned coal/ wood loading every 2 hours	Yes Dis-advantage: can't use fresh wood
Kraftova Brandov	P25	From friends	93	17490	No	C 2x a season, A 1x a week L 4x a day during big frosts	Use little	Coal had to load every hour	Yes
Kuklikova Sebuzin	P25	From their son, were afraid of possible fines	92	30000/ 15000 donations	No	C 1x a year A 2x a week	Use little	Coal Often had to clean pipes	Yes
Stula Sebuzin	P22	TV advertisement, friend	92	15000/ 15000 donations	No	C 1x a week A 1x a week L 4x a day	Do not use	same	No Procurement of wood, managing appliance,

									heavy manual labour
Smola Dolni Zalezly	P24	Neighbours	94	30000/15000 donations	No	C 2x a season A 1x a week L 1x 12 hours	Do not use	Now is better	Yes clean, cheaper, less physical work
Kohakova Dolni Zalezly	P45	Advertisement	92	30000/30000 donations	No	L 1.5 hours a day A 1x in three days 3x service	Little use	Less work, dirt no heavy labour	Yes, even disabled son can manage
Kostalova Sebuzin	P?	Neighbour, TV	93	25000/30000 donations	No	C sometimes A 1x in four days L 1x in 12 hours	Little use	Less time spent on loading	Yes, less heavy labour, less ash
Krten Usti nad Labem	P25	Advertisement	95	27000	No	Used only during frosts C 1x a month A 1x a week L 2-3x a day	Do not use	Similar	Yes Adjusting temperature is easier than when used coal

1 more flats in a house

Answers of interviewees who did not use wood

Name	1	2	3	4	5	6	7	8	9
Drozova Brandov	Light fuel oil boiler 32kW	-	94	60000	No	1x2 months 2 hours of cleaning	2 hours outside the heating season	Previously burnt coal – loading 33 times a day	Happy with operation but very expensive
Vodrazka	Dakon dor 32	-	86	4000	No 3	Coal and wood	Do not use	Less loading	Yes Less labour

	(coal)				(stoves)	2hours a day		than before	
Bolech Litomerice	Boderus 25 (gas)	-	95	30000	Yes	0	0	Old appliance needed more service	Yes Much smaller consumption than before
Anonymus Sebuzin	Gas boiler	-	94	30 000 (15 000 donation)	No (light)	0	0	No time spent	Yes No labour

Part 2

In this part I would like to ask you about the fuel you use in your boiler (stove).

1. What fuel do you use in you boiler (stove)?

Fuel wood (FW)

Wooden briquettes (WB)

Other

2. Do you buy fuel?

3. Do you buy fuel from a single source or from several suppliers?

4. Do you think that the price you pay for fuel represents a good value?

5. What is the most that you think it would be worth paying for your present fuel (in a year)?

A 6000Kc(186 Euro) B 9000Kc(281 Euro) C 15000Kc(469 Euro) D 20000Kc(625 Euro)

6. Do you physically engage in obtaining and preparing of fuel?

If yes how do you organise this activity and how long does it take? (does somebody help you, how long does it take, how often)

7. Are you satisfied with procurement of wood?

(is it enough of wood, is it easily procurable, would you prefer to obtain it in a different way /for example so that there would be less physical labour)

8. Do you regard wood as a convenient fuel?

If yes why?

If not why?

9. Do you think that heating with fuel wood should be supported from 'above'? (by the government or local councils) If yes, how (donations, advertising, better organisation of supply, support of central biomass heating projects)

Answers of interviewees who used wood

Name	1.	2.	3.	4.	5.	6.	7.	8.	9.
Jezkova Brandov	FW Sawdust	Yes	1	Yes very	A	Yes Once a year 3 families prepare fuel together	Yes Physical labour is not a problem	Yes Cheap Physical labour is a small disadvantage	Yes donations, advertising
Kraftova Brandov	FW Sawdust, tried briquettes-expensive	Yes	1	Yes	Up to 8000 Kc	Yes Once a year 3 families together Approx. 42 hours in four people	Yes, there is and will be enough wood	Cheap, excellent fuel	Yes, Loans, Advertising is sufficient lack of funds for district heating
Kuklikova Sebuzin	FW tried briquettes-	Yes	Yes Reliability of	Yes	Up to 8000 Kc	Yes, family helps, too	There is enough	I do not know	Yes. Donations, better

	expensive		suppliers varies			much heavy labour	wood, difficult to access wish: less labour		advertising and better organisation of supply
Stula Sebužin	FW Sawdust	Yes	Several	Yes but labour, same as with coal	Pays 12 000 (too high)	Buys delivery, heavy labour 56 hours in 2	Not easy to find supply of wood	Yes, if it was easier to find	Yes. Donations, better advertising and better organisation of supply
Smola Dolni Zalezly	FW	Yes	Several	Yes	A	Organise delivery, cutting, family helps	Enough wood, easy to access, wish: less labour	Yes	Yes. Donations, better advertising and better organisation of supply
Kohakova Dolni Zalezly	FW	Yes	Several Problems with delivery	Until now yes but it is growing	C	Son, 56 hours in one person	Enough wood, but not easy to access, wish: less labour	Yes, better and cleaner fuel than coal	Yes. Donations, better advertising and better organisation of supply
Kostalova Sebužin	FW	Yes	Yes	Yes but it is growing	A	Yes, 16 hours in three people	Not aware if there is enough wood, I wood wish	Yes, nicer, cleaner fuel	Yes Donations, better advertising and better organisation of

							less labour		supply
Krten Usti nad Labem	FW	Yes	Yes	Yes	A	Yes, 24 hours in one person	Enough wood but availability is a growing problem	Yes, Environmentally friendly	Yes, in areas where there is no access to gas

2. Questionnaire for people who live in similar conditions (area) and use other domestic fuels than fuel wood.

The design of the questionnaire only differed in questions 7 – 9

7.What are in your opinion advantages of the fuel you use?

The goal was to find out what why they preferred the fuel they were using to other fuels.

8.What do you think about wood as a fuel?

Advantages (A):

Disadvantages (D):

The purpose was to collect information about the respondents awariness of wood as a fuel.

9.Have you ever heard about specially designed boilers burning wood?

The purpose was to collect information about the respondents awariness of wood as a fuel.

Answers of interviewees who did not use wood

Name	1	2	3	4	5	6	7	8	9
Drozova Brandov	Light fuel oil	Y	2	No	B (but pays 18000)	Environmentally friendly automati	High price	A: D: labour	From sister who has it

						c			We also want to buy it
Vodraz-ka	Li-gnite wood	Y	more	Coal no Wood yes	2800	No	Ash	A: cheaper than coal D: labour	From a neighbour
Bolech Lito-merice	Gas	Y	-	1	D	High heating properties	Danger for children	A: likes using wood in fireplace D: needs large storage space, difficult to get	Adverts, newspaper, not suitable for use in a town
Anonymus Sebuzin	Gas	Y	1	More expensive than coal but no labour	B	No labour	-	A: nice in a fireplace B; labour, not suitable for old people like me	No

Part 3

In this part of the questionnaire I would like to ask what are your feelings about the environment in which you are living.

1. How long have you been living in Northern Bohemia?
2. In your opinion, what are the major problems in the region and how should they be eradicated?
3. In your opinion, what represents the major environmental problems facing society in the region and how should they be eradicated?
4. What do you usually do in your spare time?
5. Do you think that heating with wood has a future in your area where you are living
If yes, why?
If no, why?
6. Do you think that heating with wood has a future in your region?
If yes, why?
If no, why?
7. What are in your opinion major obstructions to development of heating with wood in North Bohemia?

Answers of interviewees who used wood

Name	1.	2.	3.	4.	5.	6.	7.
Jezkova Brandov	41 since birth	Transport Supply problems Local unemploy- ment	Locally OK El. Power interrupti ons – solutions: wind el. Power stations	House and garden, sawing, weav- ing	Yes Quantity of wood	Yes Quanti -ty of wood	Lazi- ness In- suffici ent adverti -sing
Kraftova Brandov	36	Transport Supply problems Local unemploy ment	Air pollution Solution: close down a local polluting company	Garden ing Produc -tive garde- ning Keep- ing	Yes There is surplus wood	Yes Quanti -ty of wood	Re- quires physi- cal labour

				rabbits			
Kuklikova Sebuzin	51	Did not want to answer	Problems are not tackled	Garden ing Produc tive gardeni ng Books in winter	Yes but not for old people	Yes but there is not e- nough wood for everyb ody	There are not many trees plan- ted.
Stula Sebuzin	51	Did not know	Was not aware of local environm ental problems	My job is my hobby	Yes there is enough wood but not very well accessible	High consu mption of wood would cause its declini ng availa bility	Bad accessi bility, bad organi sation of supply . One needs a chain saw and a circu- lar saw
Smola Dolni Zalezly	50	Co- rruption, unhappi- ness with the govern- ment's actions	Air pollution – problem is not being tackled	Huntin g, fishing, kynolo gy, gardeni ng, animal keepin g	Yes Forest are near	Yes but I am not inform ed about the conditi ons elsewh ere in this region	Mental ity, lack of financ es, adver- tising, autho- rities do not suppor t it
Kohakova Dolni Zalezly	51	Crime, environm ental	Everythin g in connectio	Garden ing	No because supply is	Yes becaus e of	Transp ort of fuel

		problems	n with coal – devastated landscape, air pollution Limit coal power station and replace them with wind and hydro		unreliable and because municipality has gas pipes	quantity of wood from damaged forests	
Kostalova Sebužin	72 since birth	Crime	Smog	Reading TV	Yes, it is clean	Yes, it is clean	Bad accessibility of wood
Krten Usti nad Labem	37 since birth	There are many	Water pollution, damaged forests. Solution: fines to polluters which should be invested in improvement	Cycling, tennis, jogging	Yes in cases where there is not gas	Did not know	Heavy physical labour

Answers of interviewees who did not use wood

Name	1	2	3	4	5	6	7
Drozova Brandov	All life	Insufficient public transport	Air pollution it is not improving	Knitting, little productive gardening keeping rabbits	Yes if prices of other fuels do not change	Yes but only in mountains	Forests are disappearing Labour It would be good to order it somewhere
Vodrazka	1945	The environment	Air pollution	Productive	No People	I don't know	Coal is more

		ent	It is not my business	gardening Animal keeping	heat with electricity	but I am for wood	comfortable
Bolech Lito-merice	All life	Air water forest pollution Limit polluters	Air water forest pollution Limit polluters	Sport Guitar Tourism Gardenin g Also productive	No people prefer comfort	Yes, environmental reasons in villages	There is gas in towns people are used to comfort
Anonymus Sebuzin	All life	Crime unemployment	Air pollution: chemical companies and power stations should move somewhere else	Productive gardening Keeping animals, making wine	Maybe yes, there is a lot of wood in local forests	-	I don't know

Part 4

Finally I would like to ask you some further questions about yourself and your personal situation

1. In which year you were born? I was born in 19...

2. What formal qualifications you have gained? (please tick)

basic school

apprenticeship

(c) A-levels: gymnasium

technical high school

other

(d) Higher education (please specify): university

polytechnic

Post-gradual

Other (please specify)

3. Do you own the house (flat) in which you are living?

4. How many rooms are in the house (flat) in which you are living?

5. How many people live in your household?

Number of adults

Number of children

6. Which of these statements best describes what you (and your partner) were doing last week (that is seven days ending last Sunday)? If you were on holiday, what was your major occupation before you went away? (please tick)

You Your partner

- (a) In paid full-time work (42.5 hours a week or more)
- (b) In full-time education
- (c) In paid part-time work (less than 42.5 hours a week)
- (d) Unemployed
- (e) On maternity leave

Permanently sick or disabled

- (g) Retired
- (h) Looking after the home
- (i) Other (please specify)

7. What best describes your and your partner's work? If you are not working now, please think about the most recent job you held. (please tick)

- | You | Your partner |
|-----|---|
| (a) | Farmer or farm manager |
| (b) | Farm worker |
| (c) | Skilled manual work
(e.g. plumber, electrician, cook,
hairdresser) |
| (d) | Semiskilled or unskilled manual
work (e.g. cleaner) |
| (e) | Professional or technical work
(e.g. doctor, school teacher, engineer,
social worker, accountant, computer
programmer) |
| (f) | Manager (e.g. company director,
manager, local authority officer) |
| (g) | Clerical (e.g. clerk, secretary,
telephone operator) |
| (h) | Sales (e.g. shop assistant, commercial
traveller) |
| (i) | Other (please specify below) |
| (j) | Never had a job |

8. Are you employed locally?

If yes how long does it take you to get from your home to work?

9. Do you commute to work?

If yes how long does it take you to get from your home to work?

10. The average month's salary in the Czech Republic is approximately 8000Kc (before tax). Compare it with your (and your partner's) monthly income. Is the amount of money you (and your partner) earn sufficient for the needs of your household?

- | You | Your partner |
|-----|--------------------------|
| a) | much lower |
| b) | lower and insufficient |
| c) | lower but sufficient |
| d) | average (approx. 8000Kc) |
| e) | more and sufficient |
| f) | more and insufficient |
| g) | much higher |

11. Below I present a number of statements about the reasons which may have led you to using wood as a fuel.

Please circle one number on each line below

	Strongly disagree 1	Dis agree 2	Neither agree or disagree 3	Rather agree 4	Strongly agree 5
(a) I have always used wood as a fuel	1	2	3	4	5
(b) Wood is cheaper than other fuels	1	2	3	4	5
(c) Burning wood in a specially designed boiler does not pollute the environment	1	2	3	4	5
(d) Burning wood in a specially designed boiler produces small amounts of ash	1	2	3	4	5
(e) Burning wood in a specially designed boiler is a modern way of heating my house	1	2	3	4	5
(f) In comparison with	1	2	3	4	5

boilers
for other fuels, I found the
boiler
which burns wood financially
attractive
(g)Possibility of getting
donation

1 2 3 4 5

12. Which of the following environmental problems should be paid attention most?

Pick five most important problems. '1' gets the most important problem, '2' the
second most important problem, etc, '5' the least important problem.

excessive noise

landscape protection

air pollution

quality of water

pollution in food

radioactive pollution (nuclear power stations, transport and disposal of radioactive
waste)

pollution in rivers

global warming (greenhouse effect)

ozone hole

decline in plant and animal species

growths of the world's population

acid rain

devastation of rain forests

desertification

total exploitation of the world's stock of coal, oil and gas